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INTRODUCTION

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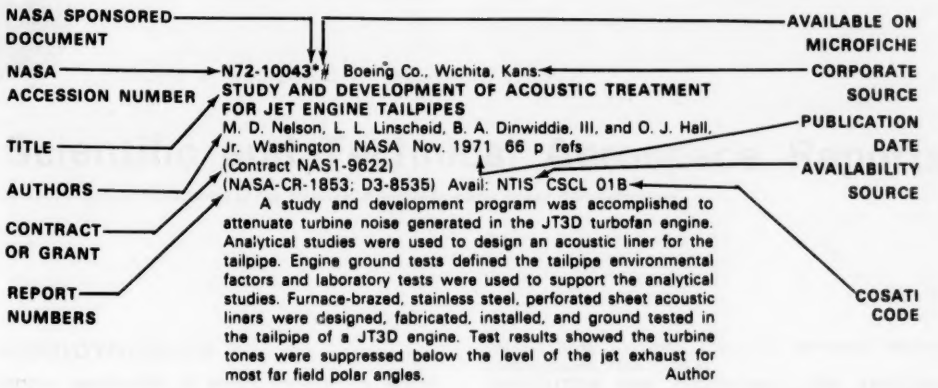
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N72-10043*# Boeing Co., Wichita, Kans.
STUDY AND DEVELOPMENT OF ACOUSTIC TREATMENT FOR JET ENGINE TAILPIPES
M. D. Nelson, L. L. Linscheid, B. A. Dinwiddie, III, and O. J. Hall, Jr. Washington NASA Nov. 1971 66 p refs
(Contract NAS1-9622)
(NASA-CR-1853; D3-8535) Avail: NTIS CSCL 01B
A study and development program was accomplished to attenuate turbine noise generated in the JT3D turbofan engine. Analytical studies were used to design an acoustic liner for the tailpipe. Engine ground tests defined the tailpipe environmental factors and laboratory tests were used to support the analytical studies. Furnace-brazed, stainless steel, perforated sheet acoustic liners were designed, fabricated, installed, and ground tested in the tailpipe of a JT3D engine. Test results showed the turbine tones were suppressed below the level of the jet exhaust for most far field polar angles. Author

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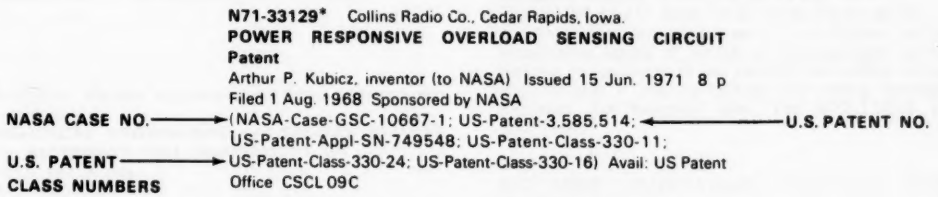
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U.S. PATENT CLASS NUMBERS
U.S. PATENT NO.
N71-33129* Collins Radio Co., Cedar Rapids, Iowa.
POWER RESPONSIVE OVERLOAD SENSING CIRCUIT Patent
Arthur P. Kubicz, inventor (to NASA) Issued 15 Jun. 1971 8 p
Filed 1 Aug. 1968 Sponsored by NASA
(NASA-Case-GSC-10667-1; US-Patent-3,585,514; US-Patent-Appl-SN-749548; US-Patent-Class-330-11; US-Patent-Class-330-24; US-Patent-Class-330-16) Avail: US Patent Office CSCL 09C

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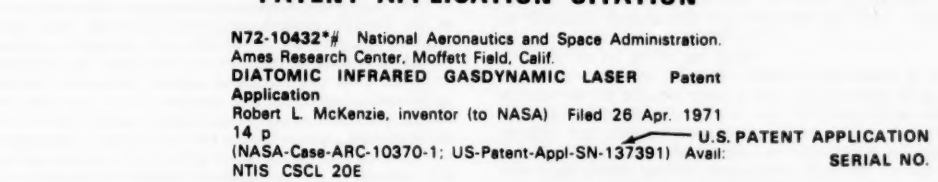
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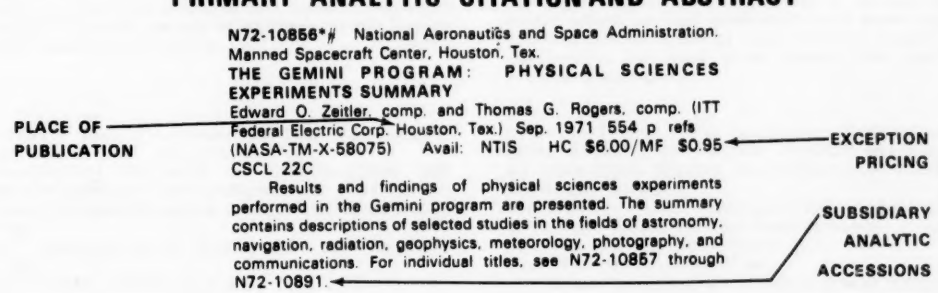
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Results and findings of physical sciences experiments performed in the Gemini program are presented. The summary contains descriptions of selected studies in the fields of astronomy, navigation, radiation, geophysics, meteorology, photography, and communications. For individual titles, see N72-10857 through N72-10891.

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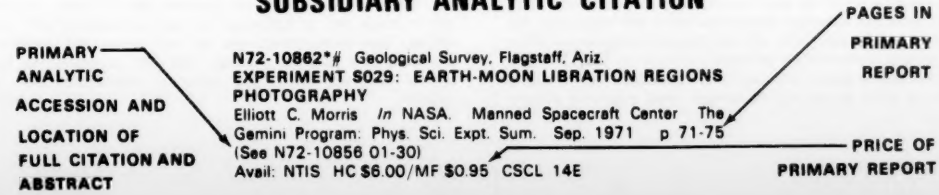
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Elliott C. Morris *In* NASA. Manned Spacecraft Center The Gemini Program: Phys. Sci. Expt. Sum. Sep. 1971 p 71-75
(See N72-10856 01-30)
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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N72-11852*+ National Aeronautics and Space Administration, Washington, D.C.

AERONAUTICAL ENGINEERING, A SPECIAL BIBLIOGRAPHY, SEPTEMBER 1971 (SUPPLEMENT 10)

Oct. 1971 141 p refs

(NASA-SP-7037(10)) Avail: NTIS CSCL 01A

This supplement to Aeronautical Engineering-A Special Bibliography (NASA SP-7037) lists 413 reports, journal articles, and other documents originally announced in September 1971 in Scientific and Technical Aerospace Reports (STAR) or in International Aerospace Abstracts (IAA). The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles. Each entry in the bibliography consists of a standard bibliographic citation accompanied by an abstract. The listing of the entries is arranged in two major sections, IAA Entries and STAR Entries in that order. The citations and abstracts are reproduced exactly as they appeared originally in IAA or STAR, including the original accession numbers from the respective announcement journals. Author

N72-11853*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A NUMERICAL METHOD OF CALCULATING THE BOUNDARY-INDUCED INTERFERENCE IN SLOTTED OR PERFORATED WIND TUNNELS OF RECTANGULAR CROSS SECTION

James D. Keller and Ray H. Wright Washington Nov. 1971 22 p refs

(NASA-TR-R-379; L-7913) Avail: NTIS CSCL 20D

A numerical method is presented for calculating the boundary-induced interference at subsonic speeds. The wind tunnel slot width or wall porosity can vary throughout the test section. The interference can be computed at any point in the test section. The model can be any configuration and can be located anywhere in the test section. Several examples are given, and comparison is made with other methods where available. Author

N72-11854# Advisory Group for Aerospace Research and Development, Paris (France).

FACILITIES AND TECHNIQUES FOR AERODYNAMIC TESTING AT TRANSONIC SPEEDS AND HIGH REYNOLDS NUMBER

Aug. 1971 409 p refs Presented at the Fluid Dyn. Panel Specialists Meeting, Goettingen, 26-28 Apr. 1971

(AGARD-CP-83-71) Avail: NTIS HC $6.00/MF $0.95

Theoretical methods and wind tunnel facilities for transonic aerodynamic testing of aircraft at high Reynolds numbers are outlined. Requirements of test facilities are clarified and possible improvements in existing facilities and testing techniques are discussed. For individual titles, see N72-11855 through N72-11887.

N72-11855# Royal Aircraft Establishment, Farnborough (England).

SCALE EFFECTS IN FLOWS OVER SWEPT WINGS

M. G. Hall *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 22 p refs (See N72-11854 03-01)

Avail: NTIS HC $6.00/MF $0.95

A review is given of the effects of variations in Reynolds number on the possible types of flow over a swept wing and the boundaries between them. Three main flow regimes are discussed in turn: the attached boundary layer which may be laminar or turbulent and where the position of transition is important; the thin wake which extends downstream from the trailing edge of the wing; and the regime of separated flow. Their interactions with the external flow and with each other are included. The flow structures are three dimensional in general. Reynolds number effects are best understood where simple extensions from two dimensions can be made. The most serious gaps in understanding are found where compressibility and strong interactions are important. Author

N72-11856# Royal Aircraft Establishment, Bedford (England).

SOME ASPECTS OF VISCOUS INVISCID INTERACTIONS AT TRANSONIC SPEEDS, AND THEIR DEPENDENCE ON REYNOLDS NUMBER

J. E. Green *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 12 p refs (See N72-11854 03-01)

Avail: NTIS HC $6.00/MF $0.95

Current understanding of viscous-inviscid interactions is reviewed, with particular reference given to the characteristics of interactions on transonic swept wings and their dependence upon Reynolds number. Interactions of three different degrees are discussed: the weak interaction between boundary layer and wake development overall and the flow field at large; the strong but localized interaction beneath shockwaves and at trailing edges in fully attached flow; and the strong interactions which involve boundary layer separation and hence have an important

effect on the entire flow field. Finally, the possibilities are discussed of manipulating the boundary layer in order to simulate, in the wind tunnel, the viscous-inviscid interactions found at flight Reynolds numbers. Author

N72-11857# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).
A METHOD FOR CALCULATING THE TRANSONIC BUFFET BOUNDARY INCLUDING THE INFLUENCE OF REYNOLDS NUMBER
F. Thomas and G. Redeker *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 14 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

A purely theoretical method for calculating the buffet boundary of straight and swept wings including the effects of Reynolds numbers is reported. In the procedure of calculation, Sinnott's method for estimating the pressure distribution in a transonic flow with shock waves is used, as well as the methods of Walz and Cumpsty and Head for calculating turbulent boundary layers in two- and three-dimensional compressible flow. The agreement of the theoretical calculation with experimental results from wind tunnel and flight tests at various Reynolds numbers is very satisfactory. Author

N72-11858# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
A TYPE OF STALL WITH LEADING EDGE TRANSONIC FLOW AND REAR SEPARATION
J. Osborne and H. H. Pearcey *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 11 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

Surface pressure measurements are presented for a leading edge, transonic flow which occurs for high angles of incidence and for stream speeds in the medium subsonic range. A shock induced separation develops in the first 5% of the chord, and also present is the rear separation that would be expected in the low speed stall of an aerofoil having a thickness/chord ratio/greater than about 10%. Results for transition fixed and free reproduce respectively the classical features for turbulent and laminar-type interactions at the leading edge shock; these leave different disturbances in the reattached turbulent layer which then react differently on the rear separation. A few results are included for an intermediate effect on transition. The Reynolds number for all the tests was in the region of 2 x 1 million based on aerofoil chord. Author

N72-11859*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REYNOLDS NUMBER REQUIREMENTS FOR VALID TESTING AT TRANSONIC SPEEDS
William B. Igoe and Donald B. Baals *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 5 p refs (See N72-11854 03-01)
(NASA-TM-X-67412) Avail: NTIS HC $6.00/MF $0.95 CSCL 20D

The variation of wing shock location with Reynolds number has been examined for configurations for which both flight and wind tunnel wing pressure distribution data were available to determine if there is a minimum level of Reynolds numbers, short of full scale, at which reliable flow simulation can be achieved in transonic test facilities. The shock locations as a function of Reynolds numbers at conditions of constant Mach number and angle of attack were normalized so that shock position was obtained in relative terms from zero to unity for each configuration and condition studied. Normalizing the shock location permitted the comparison of data for different configurations and conditions on a common basis. Not enough data have been analyzed thus far to obtain conclusive results. Author

N72-11860# Northrop Corp., Hawthorne, Calif. Aircraft Div.
RECENT EXPERIENCE IN THE TRANSONIC TESTING OF TWO DIMENSIONAL SWEPT AND STRAIGHT WINGS WITH HIGH LIFT DEVICES
W. E. Grahame, J. W. Headley, and L. W. Rogers *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 17 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

The results of a series of transonic tests of two dimensional wings with various high lift devices are presented. The tests were performed in an aerodynamic transonic wind tunnel on an unswept wing with a jet flap and a swept wing with boundary control devices. Both wings were tested through a Mach range of M = 0.70 to M = 0.95 and a Reynolds Numbers range of 2.5 to 5.5 million per foot. Additional tests included a supercritical wing with slot blowing and a leading edge flap with a jet flap. Comparisons of wing pressure distributions and flow visualization studies illustrate the effectiveness of the jet flap and also the high lift devices in controlling flow separation. Longitudinal characteristics which show the effects of Reynolds number are also presented. Comparative analyses indicating the improvement obtained with each of the high lift devices is shown. Author

N72-11861# National Aeronautical Establishment, Ottawa (Ontario).
THE TRANSONIC PERFORMANCE OF TWO DIMENSIONAL, JET FLAPPED AEROFOILS AT HIGH REYNOLDS NUMBERS
D. J. Peake, H. Yoshihara, D. Zonars, and W. Carter *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 39 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

Tests in the Na transonic wind tunnel were conducted to determine the effect of Reynolds numbers on the transonic performance of a 10% aft-cambered profile with jet flaps - in particular the effect on the pressure distribution, drag divergence, and buffet onset. Distributed suction was applied on the sidewalls in the vicinity of the model to insure that the interaction of the shock was primarily with the airfoil boundary layer. The absence of sidewall suction had a significant effect upon the upper surface flow, with the shock being displaced upstream by about 15% of the chord. In the range of the Reynolds number tested, there was a noticeable effect of Reynolds number on drag divergence, and a significant effect on buffet onset. Author

N72-11862# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
EXPERIMENTAL INVESTIGATION OF THE DRAG OF WINGS WITH A BLUNT TRAILING EDGE AT TRANSONIC SPEEDS
M. Tanner *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 6 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

The possible improvement of aerodynamic profiles due to blunt trailing edges, drag and lift measurements was studied on two wings of finite span in a transonic wind tunnel. The Mach number had values from 0.5 to 2.2 and the Reynolds number was about R = 1,500,000. From these results it was possible to conclude that in order to achieve a drag reduction at transonic speeds the trailing edge thickness should not be excessive and the boattailing angle should be small. Furthermore, a special broken shape of the trailing edge is favorable for low drag at these Mach numbers. At supersonic speeds the attainable drag reduction at zero lift is greater than predicted by Chapman. The lift curve slope is greater for the wing with a blunt trailing edge than for the wing with a conventional sharp trailing edge. With the most efficient blunt trailing edge the maximum lift to drag ratio at transonic speeds is only a few per cent lower than for the wing with a sharp trailing edge. Author

N72-11863# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
FORCE AND PRESSURE MEASUREMENTS ON A SLENDER DELTA WING AT TRANSONIC SPEEDS AND VARYING REYNOLDS NUMBERS
W. Stahl, K. Hartmann, and W. Schneider *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 11 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

Transonic wind tunnel investigations were carried out on a slender delta wing with aspect ratio A = 0.52 at Mach numbers 0.5; 0.7; 0.8; 0.9; 0.95; 0.975; 1.0; 1.1; and 1.2 for angles of incidence up to about 30 deg. Normal force and pitching moments were measured, as well as spanwise pressure distributions on the wing's pressure and suction side at five cross sections. The Reynolds number was held constant at a value of Re = 2,700,000 for all Mach numbers. The normal force and pitching moment coefficients showed a noticeable dependence on Reynolds number, the pressure distribution was influenced mainly around the suction peak. Successful attempts were made at low Reynolds number to influence the boundary layer on the wing's suction side by means of a carborundum band. Insight was obtained into the structure of the flow field, near sonic velocities, by using a newly developed smoke visualization technique and with the help of oil flow pictures. Author

N72-11864# Army Missile Command, Huntsville, Ala.
BODIES OF REVOLUTION AT TRANSONIC SPEEDS: THE ESTIMATION OF REYNOLDS NUMBER EFFECTS
T. H. Moulden, D. J. Spring, R. O. Saisi, K. Aoyama, and J. M. Wu *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 13 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

The experimental data presented are taken from a series of tests on a body of revolution at transonic speeds. The test Reynolds number was of the order of one million. Both mounting strut and tunnel wall interference effects are discussed. A theoretical procedure is developed to take account of the viscous effects on the body. It is shown that the potential flow theory of Wu and Aoyama gives close agreement with experimental data. However, and particularly to study separation and Reynolds number effects, it is necessary to introduce boundary layer effects in the theoretical work. Taking the displacement surface as an equivalent body for the second approximation, it is shown that only a small change in surface pressure distribution on the body is realized. Hence, it follows that in the absence of separation a large change in Reynolds number is of little significance as far as surface pressures are concerned. The general conclusion is that for a body of revolution, tunnel and mounting interference effects are more significant than Reynolds number effects, provided the flow is not separated. Author

N72-11865# Grumman Aerospace Corp., Bethpage, N.Y.
TRANSONIC AERODYNAMIC CHARACTERISTICS AND THEIR EVALUATION
Arthur A. Lambert *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 4 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

The need for more systematic transonic wind tunnel testing to spin down the effects of flow and environment combinations and to establish a more scientific basis for flight simulation and analysis is outlined. The discussion includes the effects of steady, unsteady, and mixed flow phenomena on tools used for design and evaluation of the important transonic flight performance parameters of modern aircraft i.e., max g capability, maneuvering buffet, level flight buffet, control problems, and peak drag characteristics. The design tools include trailing edge angle criteria, the effect of various sweep lines, and wing leading edge development. Wind tunnel evaluation tools include isobar contours, pressure taps, accelerometers, tuft stands, and oil flow techniques. The effects of scale and Reynolds Number in connection with various flow phenomena and associated flight conditions are also discussed. Author

N72-11866# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
TRANSONIC TESTING OF THE ENGINE NACELLE AIR INTAKE AND AFTERBODY [ENTREE D'AIR ET ARRIERE CORPS DE FUSEAU MOTEUR EN TRANSSONIQUE]
J. Leynaert *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 10 p refs In FRENCH; ENGLISH summary (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

An example is presented of the study of a double-flux engine nacelle at high subsonic Mach numbers, the investigation being made at high Reynolds numbers with two separate models for the air intake and the afterbody. The test on the afterbody shows that the conditions of variable jets do not react significantly on the upstream flow around the nacelle intake and cowl, apart from the immediate vicinity of the exhaust; this fact justifies the large scale, study of the air intake with a model supported downstream by a cylindrical tube replacing the jet. In the same way, mass-flow rate variations of the air intake do not react on the flow around the afterbody, in a given margin; this allows the study of the afterbody on an upstream sting. Author

N72-11867# Aircraft Research Association, Ltd., Bedford (England).
POSSIBILITIES FOR SCALE EFFECT ON SWEPT WINGS AT HIGH SUBSONIC SPEEDS: RECENT EVIDENCE FROM PRESSURE PLOTTING TESTS
A. B. Haines *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 11 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

The possibilities for scale effect on swept wings under supercritical flow conditions at high subsonic speeds are discussed on the basis of evidence from pressure plotting tests on a variety of wings. For the Super VC.10, comparison of pressure distributions measured in flight, and in model tests at R = 5.4 x 1 million shows some scale effect. For other designs however, the scale effect could be much greater; the paper shows that the underfixing technique has limitations when applied to a sweptback wing. Examples are included where the flow patterns are very complex with many interacting features; in such cases, it is often difficult even to forecast whether the scale effect is favourable or unfavourable. Further improvements in swept wing design will increase the likelihood of serious scale effect. Author

N72-11868# Aeronautical Research Inst. of Sweden, Stockholm.
CORRELATION OF SOME TRANSONIC WIND TUNNEL TEST DATA TO FLIGHT TEST RESULTS FOR TWO SLENDER WING AIRPLANES
Sven Erik Nyberg *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 10 p (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

Some of the flight test data obtained on two slender wing airplanes have been correlated to transonic wind tunnel test data obtained with 1/30 and 1/50 scale models. Static stability and control derivatives as well as damping and period in pitch and dutch roll oscillations as predicted by the wind tunnel tests show good agreement with flight tests. The predicted zero lift drag for one of the airplanes was higher than the flight test drag whereas the agreement in lift induced drag was satisfactory. Predicted component loadings have been found to agree well with flight test results. Air inlet pressure recovery was slightly higher in flight than in the wind tunnel. Flow distortion at engine face shows good correlation even at high angles of attack. It is concluded from these results, that for slender wing configuration, transonic wind tunnel test data are in general reliable, even if obtained at relatively low Reynolds number. Author

N72-11869*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
A COMPARISON OF SOME AERODYNAMIC DRAG FACTORS AS DETERMINED IN FULL-SCALE FLIGHT WITH WIND-TUNNEL AND THEORETICAL RESULTS
Edwin J. Saltzman and Donald R. Bellman *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 22 p refs (See N72-11854 03-01)
(NASA-TM-X-67413) Avail: NTIS HC $6.00/MF $0.95 CSCL 20D

Reliable techniques for defining flight values of overall aircraft drag and turbulent skin friction, and the drag associated with local regions of separated flow are reported. Selected results from these studies are presented for several types of aircraft, including the X-15, the XB-70, lifting bodies, and military interceptors. These flight results are compared with predictions derived from windtunnel models or, for friction, with the Karman-Schoenherr relationship. The flight experiments have defined the turbulent skin friction to Reynolds numbers somewhat above 10 to the 8th power, the overall drag of two airplanes, base pressure coefficients for aircraft and for an aft-facing step immersed in a thick boundary layer. A flight application of a splitter plate for reducing base drag is discussed along with examples of the drag associated with afterbody flow separation for shapes having relatively large afterbody closure angles.
Author

N72-11870*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FEASIBILITY OF TESTING A LARGE-CHORD, SWEPT-PANEL MODEL TO DETERMINE WING SHOCK LOCATION AT FLIGHT REYNOLDS NUMBER
Jones F. Cahill (Lockheed-Georgia Co.), Stuart L. Treon, and William R. Hofstetter *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 11 p refs (See N72-11854 03-01)
(Contracts F33615-69-C01256; F33615-67-C-1777)
(NASA-TM-X-67414) Avail: NTIS HC $6.00/MF $0.95 CSCL 20D

As a part of a study of methods for simulating high Reynolds number aerodynamic characteristics of large aircraft, tests have been conducted in an 11-foot transonic wind tunnel to determine the feasibility of using a large chord wind panel model to investigate the variation of shock location with Reynolds number. The model was untwisted and was of constant chord and thickness. The airfoil section was that from one station on the span of a high speed transport airplane for which a substantial amount of flight and wind tunnel pressure distribution data had previously been obtained at widely different Reynolds numbers with indications of a large scale effect on shock lokation. The major findings from this study were that the variation of shock location on the panel model was identical in character, but considerably smaller over the Reynolds number range from 8.8 million to 28.0 million than that indicated by existing data on the complete wing. Generally, the panel model data on shock location and trailing-edge pressure recovery tended toward better agreement with flight data than with previous wind tunnel data on smaller complete models. Author

N72-11871# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
WIND TUNNEL QUALIFICATION BY PERFORMANCE PREDICTION AND FLIGHT VERIFICATION [VALIDITE DE LA SOUFFLERIE POUR LA PREVISION DES PERFORMANCES ET DES QUALITES DE VOL]
Ph. Poisson-Quinton *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 15 p refs In FRENCH (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

Summaries of brief data sheets are presented that contain information on new analytical prediction methods and flight tests for the development of transonic wind tunnels. Points of agreement as well as of disagreement are illustrated to stimulate new research for improving wind tunnel qualities. Author

N72-11872*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRANSONIC TESTING IN EXISTING WIND TUNNELS
c11
J. Lloyd Jones *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 8 p refs (See N72-11854 03-01)
(NASA-TM-X-67415) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

The problems of obtaining representative transonic aerodynamic data in existing wind tunnels are examined. The problems are approached by reviewing those factors which influence the accuracy of measurement and flow simulation. Examples of flow simulation anomalies are given. Demands for increased accuracy and requirements for conducting transonic investigations under conditions increasingly more susceptible to simulation anomalies are cited. Author

N72-11873# Lockheed-Georgia Co., Marietta.
SIMULATION OF FULL SCALE FLIGHT AERODYNAMIC CHARACTERISTICS BY TESTS IN EXISTING TRANSONIC WIND TUNNELS
Jones F. Cahill *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 8 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

Although newly evolving concepts will enable the construction of relatively inexpensive wind tunnels capable of producing transonic aerodynamic data at flight Reynolds numbers, a substantial portion of future aircraft development testing will be done at subscale conditions. It is imperative, therefore, that methods be developed for accurate simulation of flight aerodynamic characteristics during tests at low Reynolds numbers. Several concepts for high Reynolds number simulation have been advanced, and some have been demonstrated for isolated cases. Some of these concepts are reviewed in the light of existing data. Author

N72-11874# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
SIMULATION OF TWO DIMENSIONAL AEROFOIL FLOW AT HIGH SUBSONIC MACH NUMBERS AND HIGH REYNOLDS NUMBERS BY MEANS OF AN EQUIVALENT BODY OF REVOLUTION
W. Lorenz-Meyer *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 9 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

In order to study the effect of high Reynolds numbers on the transonic flow past two-dimensional aerofoils, an equivalent body of revolution was constructed, having a four to five times larger chord size than the corresponding aerofoil, and giving the same rate of tunnel blockage. The contour of the body was calculated by means of a source-sink distribution. Force and pressure measurements have been performed in a transonic tunnel at Mach numbers from 0.5 to 0.925 and Reynolds numbers from Re sub l = 4 million to 16 million. In the subcritical range the results show good agreement with the calculated first-order potential flow. The evaluation of minimum pressure coefficient and shock position show that from Re sub L = 8 million no significant dependence on Reynolds number exists either at subcritical or supercritical speeds.
Author

N72-11875# Hawker Siddeley Aviation, Ltd., Kingston upon Thames (England).
ON THE POSSIBILITY OF DEDUCING HIGH REYNOLDS NUMBER CHARACTERISTICS USING BOUNDARY LAYER SUCTION

Cliff L. Bore *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 10 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

It seems that the most crucial differences of characteristics from wind tunnel models to full scale aircraft stem from the fact that the boundary layers on the model are usually relatively too thick. Consequently it has been suggested that full-scale behaviour may be more accurately simulated if the thickness of the boundary were reduced appropriately by means of suction through porous strips in the surface of the models. A suitable technique would afford convenient means for varying the boundary layer thickness without stopping the wind tunnel, and should be applicable to more model configurations than conventional underfixing of transition. The implications of these propositions are examined in the light of boundary layer calculations and data. Author

N72-11876# London Univ. (England).
SOUND FIELDS GENERATED BY TRANSONIC FLOWS OVER SURFACES HAVING CIRCULAR PERFORATIONS **c23**

M. M. Freestone and R. N. Cox *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 8 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

Tests made on the sound waves radiated from perforated transonic tunnel liners having perpendicularly drilled holes have shown that a regular pattern of coherent wave fronts occurs. It is suggested that the coupling is caused by a disturbance propagating along the surface of the liner. Results from individual holes indicate that the mechanism for production of sound waves is similar to that observed from two dimensional cavities, and that the Strouhal numbers of the modes occurring can be predicted with reasonable accuracy for both normal and inclined holes using a model proposed by Rossiter. Author

N72-11877# New York Univ., N.Y.
ENGINE AIRPLANE INTERFERENCE AND WALL CORRECTIONS IN TRANSONIC WIND TUNNEL TESTS

Antonio Ferri *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 6 p (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

Recent developments of high performance airplanes have generated requirements for the prediction of the aerodynamic performance of airplane designs with extremely high accuracy. A critical review of present experimental methods led to the initiation of two separate efforts related to experiments in transonic flows: (1) determination of Reynolds number effects and the design of high Reynolds number wind tunnels; and (2) correct representation in wind tunnel tests of the interaction between engine flow and airplane characteristics, and wall interference at high lift. Author

N72-11878*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRANSONIC FREE-FLIGHT MODEL TESTING AT LARGE SCALE

Clarence L. Gillis *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 9 p refs (See N72-11854 03-01)
(NASA-TM-X-67416) Avail: NTIS HC $6.00/MF $0.95 CSCL 20D

The use of free flight models for transonic testing at high Reynolds numbers is discussed. Several specific examples of experimental investigations are briefly reviewed to illustrate the scope of research that can be conducted by utilizing the advantages of free flight models. These advantages are primarily the lack of interference or constraints imposed by test facilities and model support systems and the dynamic freedom possessed by free flight models. High Reynolds numbers are obtained by using large models flown at relatively low altitudes. It is shown that models 10 meters or more in length will be required for research at Reynolds numbers sufficiently high to provide representative simulation of flow conditions for large modern aircraft. Several methods for launching models of this size are discussed. These methods include free drops from airplanes or balloons and ground launches with the use of internal or external rocket motors. All the launching methods discussed have been successfully demonstrated on flight vehicles of the size and weight required to attain the necessary test conditions. Author

N72-11879*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ON THE USE OF FREON-12 FOR INCREASING REYNOLDS NUMBER IN WIND-TUNNEL TESTING OF THREE DIMENSIONAL AIRCRAFT MODELS AT SUBCRITICAL AND SUPERCRITICAL MACH NUMBERS **c11**

Stuart L. Treon, William R. Hofstetter, and Frank T. Abbott *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 8 p refs (See N72-11854 03-01)
(NASA-TM-X-67417) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

The aerodynamic suitability of Freon-12 for general wind-tunnel testing was investigated at low and high subsonic speeds. Static aerodynamic characteristics of two transport airplane models were determined from strain gage balance measurements in both air and Freon-12 at several Reynolds numbers. A low-speed high-lift configuration was evaluated at Mach number 0.25, and a high-speed cruise wing-fuselage combination was tested at Mach numbers up to 0.825. The data obtained in air and in Freon-12 agree well, even in stalled flow, until compressibility effects evidently become significant in air and in Freon-12 agree well, even in stalled flow, until compressibility effects evidently become significant in air. Author

N72-11880*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FACILITY CONCEPT FOR HIGH REYNOLDS NUMBER TESTING AT TRANSONIC SPEEDS **c11**

Donald D. Baals and George M. Stokes *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 12 p refs (See N72-11854 03-01)
(NASA-TM-X-67418) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

The critical need for high Reynolds number experimental capability at transonic speeds has been broadly recognized, because there have been demonstrated significant transonic scale effects on wing-shock position with related effects on drag-rise Mach number, buffet boundary, and pitching-moment characteristics. Of the various ground-based transonic facilities considered for provision of high Reynolds number capability, the conventional wind tunnel operated in a semicontinuous mode and utilizing an energy storage system is considered to have the greatest potential. A hydropumped-storage system is proposed to provide hydraulic energy on an intermittent schedule at the rate of 500,000 horsepower to propel hydraulic turbines directly coupled to the wind-tunnel fans. Author

N72-11881# ARO, Inc., Arnold Air Force Station, Tenn. Von Karman Gas Dynamics Facility.
HIGH REYNOLDS NUMBER TRANSONIC WIND TUNNELS: BLOWDOWN OR LUDWIEG TUBE? **c11**

Jack D. Whitfield, C. J. Schueler, and Rogers F. Starr *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 17 p refs (See N72-11854 03-01)
(Contract F40600-71-C-0002)
Avail: NTIS HC $6.00/MF $0.95

The results are given of a detailed comparison between a conventional blowdown transonic wind tunnel and a Ludwieg tube driven transonic wind tunnel, both designed to cover the

same Mach-Reynolds number regime. It is concluded that the Ludwieg tube driven tunnel will provide superior flow at a significantly lower cost. The data production capabilities of a Ludwieg tube driven tunnel, with appropriate design features, were surprisingly high. The production capability of the Ludwieg tube exceeds the conventional blowdown tunnel at very high Reynolds numbers and compares favorably with existing transonic tunnels at intermediate Reynolds numbers. Experimental results from a small Ludwieg tube-driven transonic research tunnel are presented and discussed. The research tunnel is equipped with variable-porosity test-section walls and an independently controlled plenum exhaust. Both static and dynamic pressure measurements are presented in preliminary form. Author

N72-11882*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

MSFC HIGH REYNOLDS NUMBER TUBE TUNNEL c11

A. Richard Felix *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 10 p refs (See N72-11854 03-01)

(NASA-TM-X-67419) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

A high Reynolds number tube tunnel is described and illustrated by drawings and photographs. Its mode of operation and performance characteristics are also described. This impulse-type tunnel has a test section diameter of 32 inches and a Mach number range from 0.2 to 2.0. The transonic test section is equipped with a variable porosity perforated wall. A maximum unit Reynolds number of 200 million per foot is produced at a Mach number of 1.3 and the maximum tunnel charge pressure of 700 psig. The useful test time is 150 milliseconds or more at all operating conditions. Some typical test section calibration results are included. Author

N72-11883# Royal Aircraft Establishment, Farnborough (England).

SOME FACTORS RELEVANT TO THE SIMULATION OF FULL SCALE FLOWS IN MODEL TESTS AND TO THE SPECIFICATION OF NEW HIGH REYNOLDS NUMBER TRANSONIC TUNNELS c11

J. Y. G. Evans and C. R. Taylor *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 13 p refs (See N72-11854 03-01)

Avail: NTIS HC $6.00/MF $0.95

Limitations and difficulties of achieving representative flow simulation in model tests are considered. Particular attention is given to obtaining design data for swept-winged aircraft at high lift coefficients, when the flow over the wing is locally transonic and sensitive to scale. Examination of the limitations due to model strength suggests that the maximum tunnel static pressure for tests at high-lift conditions is about 5atm, and consequently that full scale Reynolds numbers could only be obtained in very large tunnels. Author

N72-11884# Advisory Group for Aerospace Research and Development, Paris (France).

AGARD STUDY OF HIGH REYNOLDS NUMBER WIND TUNNEL REQUIREMENTS FOR THE NORTH ATLANTIC TREATY ORGANIZATION NATIONS c11

Robert O. Dietz *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 9 p (See N72-11854 03-01)

Avail: NTIS HC $6.00/MF $0.95

Performance and operating characteristics required in two new, high Reynolds number wind tunnels are defined, and conceptual tunnel designs which meet these requirements are given. One tunnel of the Ludwieg tube type should duplicate transonic flight Reynolds numbers and have a run time of about one second. The second, a blowdown type wind tunnel, should provide Reynolds numbers that are three or four times the maximum presently available and have a run time of about ten seconds. Author

N72-11885# Air Force Special Weapons Center, Holloman AFB, N.Mex.

HIGH REYNOLDS NUMBER TESTING BY MEANS OF ROCKET SLEDS c11

Hans J. Rasmussen *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 8 p refs (See N72-11854 03-01)

Avail: NTIS HC $6.00/MF $0.95

Most aerodynamic ground testing is conducted in facilities which move air under controlled conditions over ground-fixed test models. This paper invites attention to the opposite approach. Aerodynamic ground testing by moving test specimen through ambient air along a rigorously defined straight line path by means of rocket sleds is reported. Some basic technical facets of rocket sled testing are reviewed and characteristics as well as current capabilities of this technique are discussed with emphasis on aerodynamic and structural design of the test vehicles, on typical test trajectories, and on electronic and photo-optical data acquisition. Similitude considerations governing aerodynamic testing by this technique are discussed and typical examples of past, current, and planned test activities in this area are reviewed. Concluding, merits and limitations of this technique as compared to other ground test approaches and to flight tests are outlined. Author

N72-11886# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

WIND TUNNEL INVESTIGATION OF BUFFET LOADS ON FOUR AIRPLANE MODELS

R. Vanino and E. Wedemeyer *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 15 p refs (See N72-11854 03-01)

Avail: NTIS HC $6.00/MF $0.95

Buffet loads and buffet boundaries have been investigated in a transonic wind tunnel by measurements of bending moments at the wing roots for high subsonic Mach numbers. These tests were carried out for four airplane models having wings of different thicknesses and aspect ratios and also different angles of sweep. Simultaneous observation of oil flow patterns provided the means to study the relation between flow separation and buffeting. The test Reynolds numbers ranged from Re = 1 million to 2 million. Securing turbulent boundary layer at the shock position by means of artificial transition, no effect of Reynolds number of buffet boundaries was observed. For the models tested it was found that low sweep and low aspect ratio yield favorable buffet boundaries. Author

N72-11887# Royal Aircraft Establishment, Farnborough (England).

A SCHEME FOR A QUIET TRANSONIC FLOW SUITABLE FOR MODEL TESTING AT HIGH REYNOLDS NUMBER c12

J. Y. G. Evans *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 5 p refs (See N72-11854 03-01)

Avail: NTIS HC $6.00/MF $0.95

A wind tunnel suitable for future research and development towards better transonic aircraft should be able to achieve a Reynolds number, based on the mean chord of a typical swept-winged aircraft, of at least 40 million. Practical limits to model strength and stiffness dictate stagnation pressures below 7 atmospheres and consequently the test section must be at least 5 m in width. For this duty, a new type of facility is proposed, which combines the good driving efficiency of the continuous tunnel with the stored-energy advantage of intermittent running. Of particular importance, the tunnel would be relatively quiet to operate and should provide an extremely clean and steady flow. Author

N72-11888*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF SEVERAL POROUS CASING TREATMENTS ON STALL LIMIT AND ON OVERALL PERFORMANCE OF

AN AXIAL FLOW COMPRESSOR ROTOR
Walter M. Osborn, George W. Lewis, Jr., and Laurence J. Heidelberg Washington Nov. 1971 48 p refs
(NASA-TN-D-6537; E-5973) Avail: NTIS CSCL 20D

Several geometrically different porous casings were tested with an axial-flow compressor rotor to determine their effects upon the rotor stall-limit line and overall performance. The tests were conducted using both uniform and nonuniform inlet-flow conditions. The rotor performance with the various casing treatments is compared with that obtained with a solid casing. The ability of the various casing treatments to displace the rotor stall-limit line to lower weight flows was observed. Significant stall-margin increases were obtained with several of the porous casings. Peak efficiencies with two of the porous casings were as high as or slightly higher than that obtained with solid casing. Author

N72-11889*# Washington Univ., St. Louis, Mo. School of Engineering and Applied Science.
CONCEPTS FOR A THEORETICAL AND EXPERIMENTAL STUDY OF LIFTING ROTOR RANDOM LOADS AND VIBRATIONS. PHASE 5A: EFFECTS OF TORSIONAL BLADE FLEXIBILITY ON SINGLE BLADE RANDOM GUST RESPONSE STATISTICS
Kurt H. Hohenemser and Gopal H. Gaonkar Jun. 1971 49 p refs
(Contract NAS2-4151)
(NASA-CR-114386) Avail: NTIS CSCL 01A

Quasi-steady aerodynamics were assumed, as well as a torsion mode where the amplitude is proportional to the distance from the rotor center. Aerodynamic torsional moment inputs are limited to the region of reverse flow where the aerodynamic center and the section center of gravity are separated by half the blade chord. Thus negligible effects of blade torsional flexibility are obtained for rotor conditions with negligible reverse flow effects. Numerical examples refer to conditions with 1.6 rotor advance ratio. It was found that the random flapping response is only moderately affected by torsional flexibility. However large random torsional loads and deflections occur even if flapping is completely suppressed. The coupling of the actual flapping motion into the blade torsional motion produces a substantial increase in the random torsional loads or deflections. Author

N72-11890*# Washington Univ., St. Louis, Mo. School of Engineering and Applied Science.
CONCEPTS FOR A THEORETICAL AND EXPERIMENTAL STUDY OF LIFTING ROTOR RANDOM LOADS AND VIBRATIONS. PHASE 5B: ANALYSIS OF GUST ALLEVIATION METHODS AND ROTOR DYNAMIC STABILITY
Kurt H. Hohenemser and S. K. Yin Jun. 1971 87 p refs
(Contract NAS2-4151)
(NASA-CR-114387) Avail: NTIS CSCL 01A

The effects of various gust alleviation methods on the random blade response in flapping were studied analytically, assuming a rigid rotor support. The analytical model assumes rigid flapping blades with elastic root restraints. Linearized equations which are approximately valid at low lift conditions were used. Because of the interblade coupling from the feedback devices, the method of multiblade generalized coordinates was most convenient and was extended to include coning, differential coning, and warping of the rotor. The numerical examples cover the dynamic stability characteristics as affected by feedback gains of three- to six-bladed rotors. The number of blades had large effects on stability limits and modal time functions at these limits. The random flapping response of the blades to atmospheric turbulence was determined at 1.6 rotor advance ratio using feedback gains below the stability limit. The most effective reduction of the flapping response per unit gain was achieved with a rotor coning angle feedback. Author

N72-11891*# Washington Univ., St. Louis, Mo. School of Engineering and Applied Science.
CONCEPTS FOR A THEORETICAL AND EXPERIMENTAL STUDY OF LIFTING ROTOR RANDOM LOADS AND VIBRATIONS. PHASE 5C: DEVELOPMENT OF EXPERIMENTAL METHODS
Kurt H. Hohenemser and S. T. Crews Jun. 1971 41 p refs
(Contract NAS2-4151)
(NASA-CR-114388) Avail: NTIS CSCL 01A

Test equipment which was built and the calibration tests are described. The test equipment consists of a two-bladed rotor of 16-in. diameter, the blades of which are elastically hinged in flapping. The feathering shaft of the blades can be harmonically rotated with the help of a cam mechanism located inside the hollow rotor shaft. The frequency range measured in the rotating system can be adjusted between 0 and 80 cps and the rotor speed between 0 and 40 cps. The test equipment is for measuring the flapping response of the blades to harmonic feathering excitation. Author

N72-11892# Royal Aircraft Establishment, Farnborough (England).
FLUTTER RESEARCH IN THE UNITED KINGDOM, 1969-1971
D. L. Woodcock and A. Jocelyn Lawrence Sep. 1971 25 p refs
(RAE-TM-813) Avail: NTIS

Research projects on the subject of flutter in fixed wing aircraft are discussed. Emphasis is placed on aeroelasticity and research involving unsteady aerodynamics and vibrations. The use of hinge moment derivatives by a forced response technique is described. A numerical analysis of the aerodynamics of bodies in supersonic flow is presented. Author

N72-11893*# Scientific Translation Service, Santa Barbara, Calif.
UNIFORM FLOW PAST FINITE BODIES IN THE TRANSONIC VELOCITY RANGE
V. N. Diyesperov and O. S. Ryzhov Washington NASA Nov. 1971 21 p refs Transl. into ENGLISH from Zh. Vychisl. Mat. Mat. Fiz. (Moscow), v. 11, Jan. - Feb. 1971 p 208-221
(Contract NASw-2035)
(NASA-TT-F-13984) Avail: NTIS CSCL 01A

The problem of uniform transonic ideal gas flow past finite bodies was considered. In the neighborhood of the sonic line the flow was fairly well approximated by the Karman equation, the solution of which was sought in a class of self-similar functions in the form of a series in powers of the distance from the body. A study was made of systems of natural and intrinsic functions introduced by Gudlerley in an analysis of transonic ideal gas flow past finite bodies within the framework of the Karman equation. Author

N72-11894*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND TWO DIMENSIONAL CASCADE TEST OF A JET-FLAP TURBINE STATOR BLADE WITH RATIO OF AXIAL CHORD TO SPACING OF 0.5
Roy G. Stabe Washington Dec. 1971 21 p refs
(NASA-TM-X-2426; E-6479) Avail: NTIS CSCL 20D

A jet-flap blade was designed for a velocity diagram typical of the first-stage stator of a jet engine turbine and was tested in a simple two-dimensional cascade of six blades. The principal measurements were blade surface static pressure and cross-channel surveys of exit total pressure, static pressure, and flow angle. The results of the experimental investigation include blade loading, exit angle, flow, and loss data for a range of exit critical velocity ratios and three jet flow conditions. Author

N72-11895*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL TECHNIQUES FOR EVALUATING STEADY-STATE JET ENGINE PERFORMANCE IN AN ALTITUDE FACILITY
John M. Smith, Chi Y. Young, and Robert J. Antl Washington

Nov. 1971 39 p refs
(NASA-TM-X-2398; E-6392) Avail: NTIS CSCL 20D

Jet engine calibration tests were conducted in an altitude facility using a contoured bellmouth inlet duct, four fixed-area water-cooled exhaust nozzles, and an accurately calibrated thrust measuring system. Accurate determination of the airflow measuring station flow coefficient, the flow and thrust coefficients of the exhaust nozzles, and the experimental and theoretical terms in the nozzle gross thrust equation were some of the objectives of the tests. A primary objective was to develop a technique to determine gross thrust for the turbojet engine used in this test that could also be used for future engine and nozzle evaluation tests. The probable error in airflow measurement was found to be approximately 0.6 percent at the bellmouth throat design Mach number of 0.6. The probable error in nozzle gross thrust measurement was approximated 0.6 percent at the load cell full-scale reading. Author

N72-11896*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

COMPARISON OF SEVERAL METHODS FOR ESTIMATING LOW SPEED STABILITY DERIVATIVES

Herman S. Fletcher Washington Nov. 1971 33 p refs
(NASA-TN-D-6531; L-7914) Avail: NTIS CSCL 01B

Methods presented in five different publications have been used to estimate the low-speed stability derivatives of two unpowered airplane configurations. One configuration had unswept lifting surfaces, the other configuration was the D-558-II swept-wing research airplane. The results of the computations were compared with each other, with existing wind-tunnel data, and with flight-test data for the D-558-II configuration to assess the relative merits of the methods for estimating derivatives. The results of the study indicated that, in general, for low subsonic speeds, no one text appeared consistently better for estimating all derivatives. Author

N72-11897*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

APPLICATION OF QUADRATIC OPTIMIZATION TO SUPERSONIC INLET CONTROL

Bruce Lehtinen and John R. Zeller [1971] 11 p refs Presented at the 5th Congr. of the Intern. Federation of Autom. Control, Paris, 12-17 Jun. 1972
(NASA-TM-X-67907; E-6512) Avail: NTIS CSCL 01C

The application of linear stochastic optimal control theory to the design of the control system for the air intake (inlet) of a supersonic air-breathing propulsion system is discussed. The controls must maintain a stable inlet shock position in the presence of random airflow disturbances and prevent inlet unstart. Two different linear time invariant control systems are developed. One is designed to minimize a nonquadratic index, the expected frequency of inlet unstart, and the other is designed to minimize the mean square value of inlet shock motion. The quadratic equivalence principle is used to obtain the best linear controller that minimizes the nonquadratic performance index. The two systems are compared on the basis of unstart prevention, control effort requirements, and sensitivity to parameter variations. Author

N72-11898*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DRAG OF A SUPERCRITICAL BODY OF REVOLUTION IN FREE FLIGHT AT TRANSONIC SPEEDS AND COMPARISON WITH WIND TUNNEL DATA

J. W. Usry and John W. Wallace Washington Dec. 1971 40 p refs
(NASA-TN-D-6580; L-8019) Avail: NTIS CSCL 20D

The forebody drag of a supercritical body of revolution was measured in free flight over a Mach number range of 0.85 to 1.05 and a Reynolds number range of 11.5 x 10 to the 6th power to 19.4 x 10 to the 6th power and was compared with wind-tunnel data. The forebody drag coefficient for a Mach number less than 0.96 was 0.111 compared with the wind-tunnel value of 0.103. A gradual increase in the drag occurred in the Langley 8-foot transonic pressure tunnel at a lower Mach number than in the Langley 16-foot transonic tunnel or in the free-flight test. The sharp drag rise occurred near Mach 0.98 in free flight whereas the rise occurred near Mach 0.99 in the Langley 16-foot transonic tunnel. The sharp rise was not as pronounced in the Langley 8-foot transonic pressure tunnel and was probably affected by tunnel-wall-interference effects. The increase occurred more slowly and at a higher Mach number. These results indicate that the drag measurements made in the wind tunnels near Mach 1 were significantly affected by the relative size of the model and the wind tunnel. Author

N72-11899*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NUMERICAL CALCULATION OF TRANSONIC FLOW ABOUT SLENDER BODIES OF REVOLUTION

Frank R. Bailey Washington Dec. 1971 38 p refs
(NASA-TN-D-6582; A-4115) Avail: NTIS CSCL 20D

A relaxation method is described for the numerical solution of the transonic small disturbance equation for flow about a slender body of revolution. Results for parabolic arc bodies, both with and without an attached sting, are compared with wind-tunnel measurements for a free-stream Mach number range from 0.90 to 1.20. The method is also used to show the effects of wind-tunnel wall interference by including boundary conditions representing porous-wall and open-jet wind-tunnel test sections. Author

N72-11900*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT-DETERMINED AERODYNAMIC STABILITY AND CONTROL DERIVATIVES OF THE M2-F2 LIFTING BODY VEHICLE AT SUBSONIC SPEEDS

Robert W. Kempel and Ronald C. Thompson Washington Dec. 1971 34 p refs
(NASA-TM-X-2413; H-520) Avail: NTIS CSCL 01B

Aerodynamic derivatives were obtained for the M2-F2 lifting body flight vehicle in the subsonic flight region between Mach numbers of 0.41 and 0.64 and altitudes of 7000 feet to 45,000 feet. The derivatives were determined by a flight time history curve-fitting process utilizing a hybrid computer. The flight-determined derivatives are compared with wind-tunnel and predicted values. Modal-response characteristics, calculated from the flight derivatives, are presented. Author

N72-11901*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AERODYNAMIC CHARACTERISTICS OF A LARGE SCALE MODEL WITH A SWEPT WING AND AUGMENTED JET FLAP

Michael D. Falarski and David G. Koenig Jul. 1971 104 p refs Prepared in cooperation with Army Air Mobility Res. and Develop. Lab.
(NASA-TM-X-62029) Avail: NTIS CSCL 01A

Data of tests of a large-scale swept augmentor wing model in the 40- by 80-foot wind tunnel are presented. The data includes longitudinal characteristics with and without a horizontal tail as well as results of preliminary investigation of lateral-directional characteristics. The augmentor flap deflection was varied from 0 deg to 70.6 deg at isentropic jet thrust coefficients of 0 to 1.47. The tests were made at a Reynolds number from 2.43 to 4.1 times one million. Author

N72-11902*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LARGE SCALE WIND TUNNEL INVESTIGATION OF A SEMISPAN WING EQUIPPED WITH AN EXTERNALLY-BLOWN JET FLAP

Michael D. Falarski and Thomas N. Aiken Jul. 1971 97 p refs Prepared in cooperation with Army Air Mobility Res. and Develop. Lab.

(NASA-TM-X-62079) Avail: NTIS CSCL 01A

A wind tunnel investigation was made of the aerodynamic characteristics of a 14.5 foot semispan, externally-blown jet flap model. The model was equipped with a single 30-inch diameter, ducted fan with a 1.03 pressure ratio. The effects of flap size, fan vertical location, and wing sweep on the longitudinal aerodynamic characteristics were studied. Author

N72-11903# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

TWO-DIMENSIONAL LOW-SPEED TUNNEL TESTS ON THE NACA 0012 SECTION INCLUDING MEASUREMENTS MADE DURING PITCHING OSCILLATIONS AT THE STALL

G. F. Moss and P. M. Murdin London Aeron. Res. Council 1971 43 p refs Supersedes RAE-TR-68104; ARC-30682 (ARC-CP-1145; RAE-TR-68104; ARC-30682) Avail: NTIS; HMSO: 60p; PHI: $2.55

Lift measurements were made on a 10% thick 0012 section under static conditions and during pitching oscillations in an attempt to provide sectional data for use in calculations on helicopter rotors. Strong three dimensional effects were found at the stall, however, which seemed to be inherent in the aerodynamics of the stall itself. Also, the cyclic variation of lift during the pitching oscillations was found to be intermittent between two distinct types during both of which considerable hysteresis was observed and during one of which very large increases in maximum lift were encountered. Author (ESRO)

N72-11904# National Physical Lab., Teddington (England). Aerodynamic Div.

OBSERVATIONS OF THREE-DIMENSIONAL FLOW PATTERNS OBTAINED DURING STALL DEVELOPMENT ON AEROFOILS, AND ON THE PROBLEM OF MEASURING TWO-DIMENSIONAL CHARACTERISTICS Progress Report

N. Gregory, V. G. Quincey, C. L. OReilly, and D. J. Hall London Aeron. Res. Council 1971 31 p refs Supersedes NPL-AERO-1309; N71-11014 ARC-31702 (ARC-CP-1146; NPL-AERO-1309; ARC-31702) Avail: NTIS; HMSO: 45p; PHI: $1.95

Three-dimensional patterns were obtained in appreciable regions of separated flow on both thick and thin aerofoils at high and low Mach numbers. A form of boundary-layer control prevented separation of flow in the corners at the aerofoil ends but did not inhibit development of the three-dimensionality. Author (ESRO)

N72-11905# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.

GUN TUNNEL FORCE MEASUREMENTS ON SOME THIN DELTA WINGS SUITABLE FOR HYPERSONIC CRUISING FLIGHT

T. Opatowski Aeron. Res. Council 1971 87 p refs Supersedes ARC-30997 Sponsored by Natl. Phys. Lab. (ARC-CP-1148; ARC-30997) Avail: NTIS; HMSO: 1.15; PHI: $4.90

Lift, drag, and pitching moment measurements are presented for six thin delta wings at a Mach number of 8.3 and compared with theoretical estimates. Consideration is given to hypersonic cruise vehicles in the atmosphere and the relevance of tunnel tests to full scale conditions. An optimum thickness is derived and compared to the tunnel results. Author (ESRO)

N72-11906# Aircraft Research Association, Ltd., Bedford (England).

RESULTS AND ANALYSIS OF PRESSURE MEASUREMENTS ON TWO ISOLATED SLENDER WINGS AND SLENDER WING-BODY COMBINATIONS AT SUPERSONIC SPEEDS. PART 1: ANALYSIS

K. A. Fellows and E. C. Carter London Aeron. Res. Council 1970 60 p refs Supersedes ARA-12; N70-17881 01-06; ARC-31724 (ARC-CP-1131; ARA-12; ARC-31724) Avail: NTIS; HMSO: 80p; PHI $3.35

The results of the measurements taken made it possible to isolate the contributions to the overall normal force made by the wing upper surface, wing lower surface, forebody, cylindrical body, and the mutual wing-body interference. Each item was compared with theoretical and empirical prediction methods currently available. Significant differences between theory and practice were discovered, particularly for the most slender wing, at high pitch angles. The vortex induced lift on the wing upper surface continues up to very high incidences especially on the most slender wing, with much higher suctions than had been predicted. New values of k, the limiting suction level, are proposed and an empirical formula relating the upper surface normal force to Mach number, leading edge sweep angle, and pitch angle is suggested for the range of these particular wings. Body interference on the wing falls off rapidly above about 10 deg but there is no loss of non-linear lift on the body due to the presence of the wings. Author (ESRO)

N72-11907# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

LOW-SPEED WIND-TUNNEL TESTS ON A FAMILY OF CAMBERED WINGS OF MILD GOTHIC PLANFORM OF ASPECT RATIO 1.4

P. J. Butterworth London Aeron. Res. Council 1971 41 p refs Supersedes RAE-TR-70185; ARC-32686 (ARC-CP-1163; RAE-TR-70185; ARC-32686) Avail: NTIS; HMSO: 55p; BIS: $2.20

The longitudinal characteristics of a family of one symmetrical and two cambered mild gothic wings of aspect ratio 1.4 and thickness-to-chord ratio of 0.09 were investigated and the results are presented with analysis. The two cambered wings were designed to have attached leading edge flow at lift coefficients of 0.1 and 0.2 respectively, at a specified angle of incidence. The force measurements and flow visualization show that the design criteria have in fact been satisfied though additional inboard shoulder separations near the apex were observed under certain conditions. Author (ESRO)

N72-11908# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

INDUCED ROLLING MOMENT CHARACTERISTICS OF THE M557A BOMB AT MACH NUMBER 0.50 STREAMLINE

P. Lee London Aeron. Res. Council 1971 60 p refs Supersedes RAE-TM-AERO-1154; AERC-31839 (ARC-CP-1157) Avail: NTIS; HMSO: 80p; BIS: $3.20

A model of a streamline bomb with fixed cruciform fins has been tested in a 8 ft x 6 ft tunnel, to examine possible reasons for the discrepancy between the rolling moments derived from free flight tests and results obtained from previous wind tunnel tests. A range of Reynolds numbers was covered corresponding to the previous tunnel test and free flight values. The effect on rolling moment of a nose probe and a launching lug, which were present in the flight but not represented in the previous tunnel tests, was also investigated. The results show that the induced rolling moment was not significantly influenced by Reynolds number, for the range covered. At incidence a large change in rolling moment resulted for the addition of the nose probe and it was shown that this rolling moment depended critically on the geometric accuracy of the spherical nose of the probe itself. Author (ESRO)

N72-11909# National Physical Lab., Teddington (England). Aerodynamics Div.

A NOVEL METHOD FOR THE ESTIMATION OF THE ZERO-LIFT FOREBODY PRESSURE DRAG OF AXISYMMETRIC NON-SLENDER SHAPES AT SUPERSONIC AND HYPERSONIC VELOCITIES

P. G. Pugh and I. C. Ward London Aeron. Res. Council 1971 28 p refs Supersedes NPL-AERO-SR-038; ARC-31761 (ARC-CP-1142; NPL-AERO-SR-038; ARC-31761) Avail: NTIS; HMSO: 40p; Bis: $1.60

A method for calculating the zero-lift drag of both blunted

and sharp forebodies is described. This uses the novel approach of first predicting the shape of the bow shock wave and then using this to compute the drag. Accuracies of drag prediction of typically 5% are achieved. Author (ESRO)

N72-11910# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
AN IMPROVED METHOD FOR CALCULATING GENERALISED AIRFORCES ON OSCILLATING WINGS IN SUBSONIC FLOW
G. Long 1971 21 p refs Supersedes RAE-TR-69073; ARC-31480
(ARC-R&M-3657; RAE-TR-69073; ARC-31480) Avail: NTIS; HMSO: 55p; BIS: $2.20

A lifting-surface theory of the Multhopp-type was revised to include an improved method of spanwise integration and programmed in FORTRAN 4. Generalized aerodynamic forces were calculated for three wings, and the effects of varying the number of collocation points and the accuracy of spanwise integration are discussed. Author (ESRO)

N72-11911# Office of Naval Research, London (England).
LIGHT HOVERCRAFT BY HOVER-AIR LIMITED
Richard D. Mathieu 7 Jun. 1971 16 p
(AD-726163; ONRL-R-17-71) Avail: NTIS CSCL 01/3

The development of light hovercraft for the performance of tasks which require an amphibious capability to travel in inaccessible areas is progressing at a rapid pace. One of the largest manufacturers of light hovercraft has been Hover-Air Limited of England. The report summarizes the design data and performance data of four craft, and discusses their potential applications. Author (GRA)

N72-11912# Army Foreign Science and Technology Center, Charlottesville, Va.
ON THE QUESTION OF CONSTRUCTION OF TANGENTS TO THE CROSS SECTIONS OF AN AIRPLANES'S WING, UTILIZING A DISCRETE NUMBER OF POINTS
M. A. Manevich 21 Jul. 1971 7 p refs Transl. into ENGLISH from Kvoprosu O Postrdenii Kasatelnykh K Poperechnym Secheniyam Kryla Samoleta Zadannym Diskretnymi Ryadami Tochek, Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekhn., Kazan
(AD-728651; FSTC-HT-23-523-71) Avail: NTIS CSCL 01/3

A method of construction of tangents to the cross section of the wing of an airplane by plotting a discrete number of points, is described. GRA

N72-11913# California Univ., Berkeley. Div. of Aeronautical Sciences.
AN EXPERIMENTAL INVESTIGATION OF SUPERSONIC FLOW PAST YAWED CONES
Rafael Yahalom Apr. 1971 86 p refs
(Grant AF-AFOSR-0268-67; AF Proj. 9781)
(AD-728233; AS-71-2; AFOSR-71-2183TR) Avail: NTIS CSCL 20/4

An experimental investigation of supersonic flow around cones was conducted in a supersonic wind tunnel, at a free stream Mach number of 2.72 and Reynolds number per foot of 1,660,000. Three cones of semi-apex angles of 10 deg, 15 deg and 20 deg were investigated at relative incidences alpha divided by theta sub c up to 3. In addition to measuring surface pressure, a detailed study of the flow in the plane of symmetry phi = 180 deg was made by means of a pitot-hot wire probe. The shape of the outer shock wave as well as of the imbedded shocks were determined. Oil and vapor screen techniques and a Schlieren system were used to visualize the flow field. For moderate angles of yaw alpha divided by theta sub c less than 1, good agreement is found between the theoretical and the experimental results. At higher angles of attack imbedded shocks are formed and two symmetrical vortices are shed on the leeward side of the cones. The concept of the lifting off of the vortical singularity appears to be meaningful in real flow and its location is determined. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc. and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N72-11914# Institut Franco-Allemand de Recherches, St. Louis (France).
AIRCRAFT BOOM DISTRIBUTION DURING SUPERSONIC FLIGHT IN QUIET ATMOSPHERE. PART 2: HORIZONTAL TURN AT CONSTANT VELOCITY [PROPAGATION DU BRUIT BALISTIQUE D'UN AVION DANS L'ATMOSPHERE NON PERTURBEE. 2 PARTIE: AVION EN VOL HORIZONTAL A VITESSE CONSTANT. APPLICATION AU VIRAGE]
F. Reggiani 1970 48 p refs In FRENCH
(ISL-12/70) Avail: NTIS

A FORTRAN IV program for the IBM 360 yielded the geometric elements of shock layers as a function of aircraft trajectory. Propagation of shock waves through tubes was considered. The airplane was assumed to fly at constant velocity and altitude, in an atmosphere with constant temperature gradient and without wind. The trajectory was a circular arc transitioned halfway to the right. Grounded traces of isoemission and isoreception surfaces were calculated, as well as the position of singular points (points of transition and upturn) and the radii of curvature of the surfaces at these points. Numerical results are presented for Mach 1.3 and 1.7. Transl. by K.P.D.

N72-11915# Advisory Group for Aerospace Research and Development, Paris (France).
HELICOPTER GUIDANCE AND CONTROL SYSTEMS
Sep. 1971 261 p refs Partly in ENGLISH and partly in FRENCH Presented at the 12th Meeting of the Guidance and Control Panel of AGARD, Konstanz, West Germany, 7-9 Jun. 1971
(AGARD-CP-86-71) Avail: NTIS

Papers on military helicopter technology are presented. The topics covered include helicopter requirements, system operation and integration, subsystems, advanced developments, and test results and operational experience. For individual titles, see N72-11916 through N72-11939.

N72-11916# Defense Dept., Washington, D.C.
UNITED STATES ARMY HELICOPTER EXPERIENCES AND FUTURE REQUIREMENTS
Conrad L. Stansberry *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 6 p (See N72-11915 03-02)
Avail: NTIS

The U.S. Army has found the helicopter to be an extremely versatile vehicle in performing all functions of combat. It has been integrated into organizations throughout the Army force structure. The concepts of airmobility have been validated during combat operations in a counterinsurgency environment in Vietnam. At this time, the U.S. Army is in a period of transition requiring an assessment of the applicability of the airmobile concept in the mid and high intensity warfare environment. To improve the existing capability, new helicopters and evaluations of different types of units with organic airmobile elements to optimize the effectiveness of our combat units must be developed. It is expected that the concepts of airmobility warfare brought to fruition with the advent of the helicopter and applied so successfully in Vietnam can be applied with equal success on other battlefields in other areas in the future. Author

N72-11917# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).

OPTIMIZATION OF AUTOMATIC FLIGHT CONTROL CONCEPTS FOR LIGHT HELICOPTERS WITH ALL WEATHER CAPABILITY

H. Koenig and H. Schmitt *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 13 p refs (See N72-11915 03-02)

Avail: NTIS

All-weather equipment of minimum complexity for light helicopters is presented. The criteria for its selection include mission performance requirements as well as consideration of weight, complexity and cost. The special features of a helicopter with hingeless rotor are discussed. The flight control system being developed is shown by a step-by-step process up to an optimal equipment for civilian and military application in all-weather flight. This report presents the validation of flight control systems of SAS and ASE performance level. Successful flight tests of the Ferranti FAS.2 and the BSW-FRG.14 flight control equipment have been conducted on the helicopter MBB-BO 105. Good agreement has been found between theoretical and simulation studies. The systems can be used for many important military purposes. Author

N72-11918# Service Technique Aeronautique, Paris (France).

FLIGHT SAFETY WITH AUTOMATIC CONTROL: REQUIREMENTS AND IMPLEMENTATION [LA SECURITE DU VOL EN PILOTAGE AUTOMATIQUE EXIGENCES ET REALISATIONS]

A. Guibaud and D. Autechaud *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 6 p In FRENCH (See N72-11915 03-02)

Avail: NTIS

The breakdown of automatic pilots or auxiliary stabilization systems may have grave consequences for helicopter flight, since these aircraft often operate at low altitudes. Safety requirements constitute one part of a theoretical study of breakdowns; requirement implementation and testing were also studied. A probability analysis of simple and double breakdowns was undertaken. In the case of active breakdown of the automatic pilot, it is necessary to limit the rapid evolution of the apparatus and thus to increase the time allowed to the pilot to react and resume manual flight control. Surveillance devices are necessary on the automatic pilot in order to detect active breakdown and to rapidly suppress the erroneous command. Such compatibility and thereshold devices are available on the Puma and Alouette 3 aircraft. Finally, surveillance of the flight control chain, from detectors to servo-command, can be done internal organization of the automatic pilot, extending the possibilities for surveillance devices without increasing cost. Transl. by K.P.D.

N72-11919# Royal Aircraft Establishment, Farnborough (England).

THE IMPLICATIONS OF OPERATING HELICOPTERS IN POOR VISIBILITY

J. E. Nethaway *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 20 p refs (See N72-11915 03-02)

Avail: NTIS

A method of weather minima calculation is proposed for small sites and is extended to allow an estimate to be made of the instrument or automatic approach performance requirements if the weather minima are to be achieved. As an example of the estimation technique an assumption is made of a 6 deg approach path coupled with a 60 kn (111 km/h) approach speed and it is suggested that 120 ft/700 yd (36m/640m) weather minima should be attainable. The equipment requirements necessary to achieve the weather minima are considered and possible developments for the future are discussed. The future developments could include improved displays based on cathode ray tubes, and also various levels of automatic flight path control. A radio/radar guidance aid is required and the overlap between it and the visual guidance system is discussed. The approach and landing system described implies a weight penalty, the extent of which depends on the severity of the weather to be overcome. With this in mind a tentative estimate is made of the equipment weight which may be necessary to achieve various weather minima. Finally, a study has been made of the statistical occurrence of low visibility in the UK from which it has been deduced that, for the approach conditions assumed, a helicopter should be able to complete approaches to land on about 98% of occasions in the year. Author

N72-11920# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.

PROGRESS OF THE USAF INFLIGHT PROGRAM: LOW SPEED CONTROL TO LANDING ON INSTRUMENT IN HELICOPTERS

Charles A. Scolatti *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 15 p refs (See N72-11915 03-02)

Avail: NTIS

A functional flight control-display system is described which provides the small and medium sized helicopter a manual-on-instrument capability from take-off to landing. The display solution is based upon extending the capability of the flight director as it is employed today in helicopters for flying fixed wing type profiles to encompass the unique portion of the low speed regime. With respect to automatics, pilot workload has been reduced and control maneuverability enhanced by introducing innovations to the design of stability augmentation systems in the yaw and collective channels. The flight control-display system was developed using beam guidance in anticipation of the upcoming guidance system proposed by the SC-117 Committee. Testing of the system elements is complete. Evaluation of the synthesized system will be completed by the end of the year. Work is beginning on having user command personnel test the system in its applied form on two UH-1N helicopters at the USAF Instrument Pilot Instructors School. Author

N72-11921# Ambac Industries, Inc., Garden City, N.Y. Arma Div.

AN OPTIMUM MILITARY HELCIOPTER NAVIGATION SYSTEM

Marvin Taylor *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 11 p refs (See N72-11915 03-02)

Avail: NTIS

A low-cost, all-weather, self-contained navigation system was studied in order to fully exploit the many military capabilities of helicopters. Inertial, Doppler-Magnetic, and Doppler-Gyroscopic Navigation systems are analyzed to determine parametric requirements (such as gyro drift, torque scaling, and computer requirements) as a function of navigation accuracy. A study of these alternate candidate systems indicates an optimum approach is the combination of Doppler velocity with an accurate heading indicator utilizing low drift gyroscopes that can rapidly gyro-compass to true North during ground alignment. For subsonic application less precise gyro drift is required with this approach than for an equivalent all-inertial system. The various system configurations are functionally defined and cost vs performance analysis using typical parameters is performed for the alternate candidate systems. Author

N72-11922# Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).

SOME PROBLEMS IN THE DEVELOPMENT OF AN AUTOMATIC FLIGHT CONTROL SYSTEM FOR LIGHT HELICOPTERS

W. Wellern *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 15 p refs (See N72-11915 03-02)

Avail: NTIS

Some of the problems and their solution are discussed arising in the development of an automatic flight control system for light helicopters. The control system is the FRG 14/Stab. The cross coupling between the axes makes it essential to regard the helicopter control as multiloop control and to take account of all six degrees of freedom of the vehicle. These investigations were done with the aid of a program drawn up recently for analysis applied first to a light helicopter which is equipped with a

hingeless rotor (BO 105). This type of rotor shows very high control effectiveness and very fast reactions to control inputs. Thus it seems to be necessary to include the nonlinearities of actuators and hydraulic booster in the investigation and to perform a simulation on the analog computer. Here the problem of limit cycles due to backlash arises. The limit cycles are reduced by means of special nonlinear networks so that they are no longer perceived by passengers. Development of the FRG 14 System was continued by hardware simulation and concluded with good results in flight tests. Author

N72-11923# Siemens A.G., Munich (West Germany).
DIFFERENCES AND COMMONALITIES IN HELICOPTER AND FIXED WING DOPPLER SENSOR TECHNOLOGY
K. Maerz *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 5 p refs (See N72-11915 03-02)
Avail: NTIS

The possibilities and limitations of rotary and fixed wing compatible Doppler sensor designs are discussed. Measurement of velocities near zero at often relatively high values for the drift angle is a requirement for helicopters only. For fixed wing aircraft on the other hand operation at high altitudes at high speeds influence antenna and transmitter design. The lower mean speeds in helicopters put more weight on these measurement errors, which are constant relative to velocity, whereas in fixed wing aircraft in most cases measurement errors dominate which are proportional to velocity. In helicopters and VTOL aircraft fixed antenna installation is generally preferred. Whereas the use of noncoherent pulse systems is limited to fixed wing aircraft, continuous wave and FM Doppler sensors are successfully used in helicopter navigation systems. Author

N72-11924# Teledyne Systems Co., Northridge, Calif.
AN INTEGRATED LOW ALTITUDE FLIGHT CONTROL SYSTEM FOR HELICOPTERS
James P. Murphy, Herman L. Walker, and Lawrence A. Kaufman *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 20 p refs (See N72-11915 03-02)
Avail: NTIS

After a brief introduction that highlights the need for the system and some design philosophies, the basic concepts for low altitude flight are presented indicating the modes of flight employed by IHAS, terrain following (TF), and terrain avoidance (TA). This is followed by a dissertation on the functional approach used to provide the relatively high degree of TF capability required. Block diagrams are utilized to identify the system sensors, central computer and output devices, i.e., displays and flight controls. Prior to a discussion of the equations solved by the central digital computer, the equipment mechanization is briefly described to familiarize the reader with the IHAS equipments. A commentary is presented on the setup and results of a simulation of the automatic TF system and is followed by a description and limited listing of results of the IHAS flight test program. It is shown that the high degree of TF capability provided agreed very well with the results predicted by analysis and simulation. Finally, some concluding remarks are provided to identify the significant accomplishments of the IHAS low altitude control system development. Author

N72-11925# Singer-Kearfott, Pleasantville, N.Y.
OPERATIONAL CONSIDERATIONS AND APPLICATIONS OF THE TALAR(R) 4 LANDING AID TO HELICOPTERS c21
R. Hohol and J. Taylor *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 13 p refs (See N72-11915 03-02)
Avail: NTIS

The requirements of helicopter operations are discussed for using the Talar 4 system, currently in operational use by the United States Air Force to provide a portable landing aid for fixed wing tactical transport aircraft. The Talar 4 ground station characteristics are presented with helicopter flight test evaluations in Europe. It is concluded that the Talar 4 system is capable of meeting tactical helicopter operational requirements. F.O.S.

N72-11926# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
AUTOMATIC APPROACH AND HOVER COUPLER FOR HH-53 HELICOPTERS
Robert A. Andes *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 7 p refs (See N72-11915 03-02)
Avail: NTIS

The Automatic Approach and Hover Coupler which provides the HH-53 rescue helicopter with the capability to automatically transition from forward flight, anywhere within the HH-53 flight envelope, to a hover over flat or rolling terrain, independent of gross weight and center of gravity is discussed. The approach coupler design is based on an approach trajectory characterized by a constant longitudinal deceleration of .8 knots/seconds and a constant rate of descent of 300 feet/minute until a groundspeed of 40 knots is reached. At this point the rate of descent is reduced to 100 feet/minute. The hover coupler provides altitude retention within + or - 3 feet and zero knot groundspeed within + or - 1.5 knots of the Doppler radar measured velocity. A hover trim control is also provided to permit a limited repositioning of the aircraft by the pilot/copilot/ crewman during the rescue operation. The couplers satisfactorily completed environmental qualification tests at Sikorsky Aircraft Company, Stratford, Connecticut, and operational test and evaluation by the Military Airlift Command, Eglin Air Force Base, Florida. Author

N72-11927# Army Electronics Command, Fort Monmouth, N.J.
TERRAIN AVOIDANCE RADAR FOR US ARMY c07
Otto H. Schoenberger *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 14 p refs (See N72-11915 03-02)
Avail: NTIS

The objectives and the conduct of the U.S. Army's development program are reported for providing a terrain avoidance/terrain following capability for Army rotary-wing aircraft. The over-all program goals are described. Control aspects of helicopters were considered in light of TA/TF requirements with an immediate realization of their importance in any TA/TF application. As such, the control system was developed first, including terrain following command computation and coupling provision to the flight control system. A unique method of in-flight simulation of terrain and radar sensor was conceived. This airborne terrain and radar simulator allows full in-flight evaluation of the control system, and offers unlimited flexibility as to the type of terrain over which the system is to be tested without subjecting the aircraft and crew to the hazards of testing a control system in close proximity to terrain. A variable parameter terrain avoidance radar is described to replace the terrain and radar simulator after initial evaluation of the control system. The primary objective for this radar was to provide a terrain sensor with technical flexibility sufficient to allow TA/TF performance evaluation over the complete performance spectrum, ranging from simple fixed beam manual terrain following to sophisticated simultaneous terrain following and terrain avoidance, using transverse profile type display and coupling into the flight control system. Technical details of the radar design are given, including selection of the parameters. Author

N72-11928# Royal Aircraft Establishment, Farnborough (England).
THE EFFECTS OF SEMIRIGID ROTORS OF HELICOPTER AUTOSTABILISER DESIGN
H. B. Johnson *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 13 p refs (See N72-11915 03-02)
Avail: NTIS

Theoretical studies carried out into the basic problems posed by 'semi-rigid' rotor designs are described, and the directions in which automatic stabilizers for these aircraft are likely to develop are indicated. Two problems in particular were examined, viz the pitching instability with angle of attack and forward speed, and the interaction between aircraft of motion and those of the rotor dynamics. The latter problem is concerned with the rolling motion termed the 'pendulum' mode resulting

primarily from the increased coupling between fuselage and rotor. It is shown that a potential resonance between the 'pendulum' mode and the in-plane blade motion exists. Means of avoiding this by suitable design of the autostabilizer are suggested. Author

N72-11929# Societe Nationale Industrielle Aerospatiale, Paris (France).
AN AUTONOMOUS NAVIGATION SYSTEM FOR HELICOPTERS [SYSTEME DE NAVIGATION AUTONOME POUR HELICOPTERES] c21
M. Fourcade *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 8 p In FRENCH (See N72-11915 03-02)
Avail: NTIS

An autonomous navigation system which was developed for the SA-330 helicopter is described. A discussion of the components, functions, and essential characteristics of the system is presented. Flight test methods are considered for utilization in performance determination. Transl. by K.P.D.

N72-11930# Elliott Flight Automation, Ltd., Rochester (England). Flight Controls Div.
SOME DESIGN ASPECTS OF THE STABILITY AUGMENTATION SYSTEM FOR THE WG13 RIGID ROTOR HELICOPTER
D. Sweeting *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 12 p (See N72-11915 03-02)
Avail: NTIS

Some features of the AFCS designed for the Anglo-French WG13 rigid rotor helicopter are described and in particular those arising from the concept of a modular multi-role helicopter, designed both for high speed maneuverable flight at low altitudes and for operation in tightly controlled autopilot modes. A brief description of the system configuration including redundancy, safety features, sensors, and actuation system is given together with an indication of system size and weight, and electronics technology employed. The design requirements for the pitch stability augmentation system (SAS) are examined in relation to the conflicting requirements for low SAS authority for safety against the high control gains combined with large attitude changes required for stability and maneuverability. The concept of a collective autostabilizer independent of the pitch SAS is introduced which alleviates these design problems of the pitch channel and reduces considerably the effects of a pitch runaway. The design of the roll SAS channel is similarly influenced by the requirement for stability at high angles of bank during maneuvers while using the minimum of control authority; a type of roll rate demand system designed to operate over a wide range of bank angle is described together with the control system developed for the yaw axis. Author

N72-11931# United Aircraft Corp., Stratford, Conn. Avionics, Control and Support Systems Branch.
A FEASIBLE FEEL AUGMENTATION SYSTEM FOR HELICOPTERS
Harold S. Oakes *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 7 p (See N72-11915 03-02)
Avail: NTIS

A description and evaluation are given of the feel augmentation system (FAS). The FAS differs from most traditional automatic flight control systems in that, instead of augmenting the pilot's input to the control system by providing swash plate motion to stabilize the helicopter, it introduces only forces on the pilot's hand. If the pilot resists these forces, he then experiences the feel desired for continuing the maneuver he has started. If he does not resist the force, the stick will move and stabilize the aircraft so that it will stay in steady state trimmed flight. An extensive flight evaluation of the system in a CH-53A indicated a significant improvement in the handling qualities of the helicopter at high speeds, and that the aircraft could be maneuvered precisely at all airspeeds, permitting the pilot to use the entire V-N envelope. D.L.G.

N72-11932# Societe Francaise d'Equipments pour la Navigation Aerienne, Neuilly-Sur-Siene (France). Dept. Pilotage Helicoptere.
STABILITY AUGMENTATION SYSTEMS (SAS) [LES SYSTEMES D'AUGMENTATION DE STABILITE (SAS)]
Henrot *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 5 p In FRENCH (See N72-11915 03-02)
Avail: NTIS

A simple system for increasing helicopter stability is discussed. The components of the calculator and jack are described. Transl. by K.P.D.

N72-11933# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
HELICOPTER IFR FLIGHT PATH CONTROL SYSTEM
Theodor A. Dukes *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 10 p refs (See N72-11915 03-02)
(Contract DA-28-043-AMC-02412(E))
Avail: NTIS

Various aspects of piloted flight path control, including positioning, are discussed according to their significance in making decisions about the structure of the control system. The translational loop requirements, the choice of a nominal error coordinate system, and a discussion of the pilot's role, lead to a control system in which errors and error rates are displayed explicitly and the pilot uses essentially acceleration control in his main effort to control error rates or velocities in three dimensions. An integrated display contains all the information needed for the continuous loop closures. The proposed system is applicable to trajectory control in general so that considerable commonality in flying various tasks can be achieved. Author

N72-11934# Army Electronics Command, Fort Monmouth, N.J. Avionics Lab.
PRECISE IFR HOVERING: AN OPERATIONAL NEED AND A FEASIBLE SOLUTION
William P. Keane and R. Joseph Milelli *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 9 p (See N72-11915 03-02)
Avail: NTIS

A man-machine simulation program was conducted which indicates the feasibility of developing an IFR hover capability with state-of-the-art sensors, controls and displays. Display alternatives included a simple hover indicator, a flight director and a fully integrated multi-colored CRT display. Control alternatives for the CH-54 aircraft included the CH-54 ASE and two alternate systems employing load cable information feedback and velocity feedback. IFR hover was shown to be a reasonable task from a pilot workload standpoint. Displays and controls couple strongly in finding the best solution. A wide range of performance was achieved with the best systems providing a hover accuracy of 1-2 feet. All tests were performed under simulated gust conditions. A formal analysis of variance was performed on the data. These results indicate the feasibility of accomplishing more precise construction and logistical tasks by the helicopter in the near future through the use of instrument hover. The unloading of containerized ships by the helicopter is a possible application with both commercial and military advantage. Author

N72-11935# Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).
ADVANCED DOPPLER INERTIAL NAVIGATION SYSTEM FOR TRANSPORT HELICOPTER c21
V. Krogmann *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 14 p refs (See N72-11915 03-02)
Avail: NTIS

Conventional ground and in-air gyrocompassing techniques together with Doppler-inertial navigation are treated briefly. Main attention is paid to optimal ground and in-air alignment and Doppler-inertial-mixing. As far as the optimization is concerned, Kalman filter technique with a ten to fourteen element state vector is compared to a simple digital filter-technique based on recursive or non-recursive least squares. Comparison between

the least-square-technique and the Kalman-filter shows that their respective performance is roughly in the same order of magnitude without position fixes. The least-square-technique is recommended because its airborne computer requirements are by far lower than the Kalman-filter loading. This technique, as well as the Kalman-filter has the ability to recover the position error caused by initial misalignment and the performance does not depend on the magnitude of the initial misalignment. The proposed system is based on the least-square technique. Assuming a 2 - 3 minutes ground-alignment, the operational sequence for in-air alignment and Doppler-Inertial Navigation is described. The computer loading for both the ground and in-air alignment of this system is considered. Author

N72-11936# Mullard Research Labs., Redhill (England).
DESIGN AND EVALUATION OF A HELICOPTER GUIDANCE AID **c21**
R. N. Alcock, D. Atter, S. J. Robinsin, and R. P. Vincent *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 4 p (See N72-11915 03-02)
Avail: NTIS

A description of the microwave aircraft digital guidance equipment (MADGE) system is given. The system is designed as an approach aid for V/STOL and fixed wing aircraft and is particularly suited for military tactical applications and for use by helicopters. A typical MADGE ground installation comprises three man-portable units: (1) an azimuth approach angle measuring unit incorporating a transponder and means for encoding azimuth and elevation measurements; (2) an elevation, or glide-slope, angle measuring unit, and (3) an azimuth missed-approach angle measuring unit. In the aircraft there is a control panel, on which the approach data may be set by the pilot, and a transmitter-receiver, with circuits for distance measurement and for decoding the angle information. In civil applications the approach path can be pre-set for individual aircraft types. One or two monopole aerials, depending on aircraft aerial siting and observation problems, are used to give wide angle coverage. D.L.G.

N72-11937# Honeywell, Inc., Minneapolis, Minn.
FLIGHT TEST OF A HYDROFLUIDIC THREE-AXIS DAMPER ON A HELICOPTER
R. A. Evans and G. W. Fosdick *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 12 p refs (See N72-11915 03-02)
Avail: NTIS

Tests were conducted on a fixed-gain, three-axis hydrofluidic stability augmentation system (FSAS) in a UH-1C helicopter. The FSAS used a vortex rate sensor, two or more stages of amplification, and various shaping networks (lag, lag/lead, and high-pass) in each of the three axes, all mechanized with hydrofluidics. The system was designed, developed, bench tested and qualified for the environment. Reliability testing previously conducted estimated MTBF at 83,000 hours per axis (excluding servoactuator). Flight test results indicate pilot approval, operation over all airspeeds including hover, and excellent handling qualities. The FSAS performance was rated as better than that of the mechanical stabilizer bar by the pilots. Predicted high reliability was supported by a 60-hour, trouble-free fluidic controller operation. Author

N72-11938# Computing Devices of Canada, Ltd., Ottawa (Ontario).
PROJECTED MAP NAVIGATION IN MILITARY HELICOPTERS: APPLICATIONS AND OPERATIONAL EXPERIENCE **c21**
R. I. MacNab and J. C. Alexander *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 10 p refs (See N72-11915 03-02)
Avail: NTIS

Extensive flight experience has confirmed the feasibility of the projected map navigation systems (PMS) as ideally suited for military tactical aircraft, particularly helicopters. The reasons for this conclusion are explained in detail, and by documented comment from flight trial reports. The basis for concluding that the PMS are fundamentally superior to present day conventional navigation systems is also explained. In addition, a recommendation is made for implementing a particular projected map system which has been developed to the flyable prototype stage. D.L.G.

N72-11939# Centre d'Essais en Vol, Bretigny-Sur-Orge (France).
EXPERIENCE OF THE FRENCH FLIGHT TEST CENTER IN ALL-WEATHER HELICOPTER LANDING [EXPERIENCE DU CENTRE D'ESSAIS EN VOL FRANCAIS DANS LE DOMAINE DE L'ATTERRISSAGE TOUT TEMPS SUR HELICOPTERE] **c21**
P. Bloch *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 6 p In FRENCH (See N72-11915 03-02)
Avail: NTIS

Approach and landing under bad visibility conditions was the object of numerous tests for more than ten years. The performance and safety of systems was evaluated with an eye to their certification. A five-year study on the utilization of a radioelectronic rectilinear array for helicopter guidance is discussed. Transl. by K.P.D.

N72-11940# National Aviation Facilities Experimental Center, Atlantic City, N.J.
EVALUATION OF CRYOGENIC NITROGEN AS A FIRE-EXTINGUISHING AGENT FOR AIRCRAFT POWERPLANT INSTALLATIONS Final Report
George Chamberlain and Eugene Klueg Nov. 1971 147 p refs (Proj. 502-301-15X)
(FAA-RD-71-58) Avail: NTIS

Proposals were made to carry relatively large quantities of liquid nitrogen (LN2) aboard commercial aircraft for the purpose of fuel tank inverting. Secondary uses, such as powerplant fire extinguishing, were suggested. Testing was conducted to determine the feasibility of using LN2 as an aircraft powerplant fire extinguishing agent and to determine its characteristics when used as an extinguishant. These tests were made in a fire test facility using a full scale aircraft turbojet engine and nacelle for subsonic, low altitude flight condition simulation. A mockup engine/nacelle facility was also used, in which nacelle volume and airflow could be varied. JP-4 jet fuel was employed and was spray released and spark ignited. In addition, the experimentation is described, which was conducted to determine the design criteria required for an effective agent quantity, discharge rate and conditions, and distribution system configuration. The effects of an inadvertent discharge on engine components, effects of a damaged cowling, and the cooling of potential re-ignition sources are considered. Author

N72-11941# All American Engineering Co., Wilmington, Del.
RESEARCH STUDY OF COST EFFECTIVENESS OF AUXILIARY LAUNCH SYSTEMS APPLICABLE TO COMMERCIAL TRANSPORTS FOR PURPOSES OF NOISE ABATEMENT
F. M. Highley Jun. 1971 268 p refs
(Contract DOT-FA70WA-2224; Proj. 550-004-03H)
(FAA-EQ-71-1) Avail: NTIS

A cost effectiveness study was made to determine the feasibility of reducing the noise associated with aircraft taking off by applying auxiliary launch power during aircraft acceleration on the ground. Auxiliary launch system categories considered were reaction jets, catapults, aircraft exhaust augmentation, and accelerating vehicle systems. The most optimum system studied was the Steam Zipper catapult. It was selected on the basis of its ability to handle the full range of aircraft (75,000 to 1,5000,000 pound gross weight), its high speed capability (resulting in abbreviated take-off time and reduced noise level duration), shorter launch stroke (3882 feet versus 10,000 feet), ease of achieving bi-directional capability, and economy of operation. Author

N72-11942*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DIGITAL AUTOPILOTS: DESIGN CONSIDERATIONS AND SIMULATOR EVALUATIONS
Stephen Osder (Sperry Flight Systems Div.), Frank Neuman, and John Foster Oct. 1971 251 p refs
(NASA-TM-X-62094; Pub-70-1364-00-00) Avail: NTIS CSCL 01D

The development of a digital autopilot program for a transport aircraft and the evaluation of that system's performance on a transport aircraft simulator is discussed. The digital autopilot includes three axis attitude stabilization, automatic throttle control and flight path guidance functions with emphasis on the mode progression from descent into the terminal area through automatic landing. The study effort involved a sequence of tasks starting with the definition of detailed system block diagrams of control laws followed by a flow charting and programming phase and concluding with performance verification using the transport aircraft simulation. The autopilot control laws were programmed in FORTRAN 4 in order to isolate the design process from requirements peculiar to an individual computer. Author

N72-11943*# North American Aviation, Inc., Los Angeles, Calif.
XB-70 AERODYNAMIC, GEOMETRIC, MASS, AND SYMMETRIC STRUCTURAL MODE DATA
John H. Wykes and Alva S. Mori Mar. 1970 91 p refs
(Contract NAS4-1580)
(NASA-CR-116773; NA-70-158) Avail: NTIS CSCL 01A

XB-70-1 mass, structural, and aerodynamic data were updated to reflect as closely as possible the characteristics of the airplane at three specific flight conditions which were actually flown; a nominal Mach number of 0.90 at an altitude of 25,000 feet (two cases) and a nominal Mach number of 1.6 at an altitude of 40,000 feet (one case). In-flight response characteristics at a number of points on the vehicle were obtained by exciting a pair of shaker vanes on the nose of the airplane. Data were recorded with the basic stability augmentation system (SAS) operating both alone and together with the identical location of accelerometer and force (ILAF) structural mode control system. Detailed total vehicle weight, mass characteristics, structural frequencies, generalized masses, all aerodynamic data used in the present analyses, and a description of the actual mode shapes are tabulated and presented. Author

N72-11944*# Scientific Translation Service, Santa Barbara, Calif.
EFFECT OF SONIC BOOM ON STRUCTURES. THIRD REPORT: MEASUREMENT OF EIGENFREQUENCIES OF BUILDING STRUCTURES WHICH ARE SENSITIVE TO THE "BOOM"
P. DeTricaud Washington NASA Nov. 1971 35 p ref Transl. into ENGLISH of French conf. paper "Effet du Bang sur les Batiments. 3eme Rapport: Mesure des Frequences Propres des Ouvrages des Batiments Sensibles au Bang" Paris, Centre Sci. et Tech. du Batiment, Feb. 1971 p 1-31 Presented 1 Feb. 1971
(Contract NASw-2035)
(NASA-TT-F-14057; Conv-69-34-412-00-480-75-01) Avail: NTIS CSCL 01B

The first eigenfrequency, damping and dispersions were measured for various types of full-sized building partitions and ceilings. Panels were made of plaster, plaster tile, plaster brick and various sandwich constructions. Measurements were compared with theoretical predictions. Various panel fixation methods were evaluated. Author

N72-11945# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: COMMUTER AIRLINES INC., BEECHCRAFT C-45H (INFINITE 2), N497DM, BROOME COUNTY AIRPORT BINGHAMTON, NEW YORK, 22 MARCH 1971
26 Aug. 1971 26 p refs
(NTSB-AAR-71-13) Avail: NTIS

Commuter Airlines, Inc. Flight 502, a scheduled air taxi operation, crashed after a rejected takeoff from Runway 16 at the Broome County Airport, Binghamton, New York, on March 22, 1970, at approximately 1611 EST. There were nine passengers and two flight crew members on board the aircraft. The captain and two passengers were fatally injured. The Safety Board determined that the probable cause of this accident was the attempt of the pilot in command to take off with snow adhering to the airfoil surfaces. This snow caused a degradation of aircraft performance and loss of control following lift-off. This required the captain to reject the takeoff beyond a point where a safe emergency landing could be effected within the confines of the runway. Author

N72-11946# Pratt and Whitney Aircraft, East Hartford, Conn.
FAN-COMPRESSOR NOISE: PREDICTION, RESEARCH, AND REDUCTION STUDIES Final Report, 9 Jan. 1969 - 29 Jan. 1971
E. A. Burdsall and R. H. Urban Feb. 1971 407 p refs
(Contract DOT-FA69WA-2045; Proj. 550-001-01H)
(FAA-RD-71-73) Avail: NTIS HC $6.00/MF $0.95

A two-year comprehensive program on fan compressor noise was undertaken, under contract to the Federal Aviation Administration. An accurate prediction system was considered, based on theoretical concepts and empirical data, and enabling the selection of proper acoustical design choices for future engines. Experimental programs were conducted using a variety of test rigs to provide acoustic data and to validate theoretical considerations. Mathematical models were developed for each type of fan noise, and their applicability to actual engines was evaluated. Progress in understanding particular noise-generating mechanisms and the capability to predict fan noise is discussed. Author

N72-11947# Goodyear Tire and Rubber Co., Akron, Ohio.
AN INVESTIGATION OF METHODS TO CONTROL POST-CRASH FUEL SPILL FROM INTEGRAL FUEL TANKS Final Report, 1 Jul. 1969 - 31 Jan. 1971
K. D. Robinson Dec. 1971 70 p Proposed for presentation at the US Intern. Transportation Exposition, Washington, D. C., 27 May - 4 Jun. 1972
(Contract DOT-FA69NA-432; Proj. 503-101-01X)
(FAA-RD-71-75; FAA-NA-71-32) Avail: NTIS

The use of elastomer coatings, curtains, and other materials as containment methods to eliminate or control post-crash spill from aircraft integral fuel tanks was investigated. Elastomeric liner, curtain, and multilayer liner concepts were selected for evaluation in aircraft wing sections. Aircraft wing section drop tests show that very little improvement was realized with the various systems installed. The structural damage to the wing sections was of such magnitude that none of the systems were capable of success. Author

N72-11948*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GROUND NOISE MEASUREMENTS DURING LANDING, TAKE-OFF, AND FLYBY OPERATIONS OF A FOUR-ENGINE TURBOPROPELLER STOL AIRPLANE
David A. Hilton, Herbert R. Henderson, and Domenic J. Maglieri Washington Dec. 1971 40 p refs
(NASA-TN-D-6486; L-7054) Avail: NTIS CSCL 01B

Noise measurements were obtained for a four-engine turbopropeller STOL airplane during a Federal Aviation Administration flight evaluation program at the National Aviation Facilities Experimental Center. These noise measurements involved landing-approach, takeoff-climbout, and flyby operations of the airplane. A total of 13 measuring positions were used to define the noise characteristics around a simulated STOL port. The results are presented in the form of both physical and subjective measurements. An appendix is included to present tabulated

values of various subjective reaction units which may be significant for the planning and operation of STOL ports. The main source of noise produced by this vehicle was found to be the propeller, and noise levels decrease generally in accordance with the inverse-distance law for distances up to about 457 meters. For similar slant ranges, somewhat lower noise levels were experienced during flyby than during takeoff or landing.
Author

N72-11949*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INVESTIGATION OF SONIC BOOM GENERATED BY THIN, NONLIFTING, RECTANGULAR WINGS
Sanford S. Davis Washington Dec. 1971 43 p refs
(NASA-TN-D-6619; A-4109) Avail: NTIS CSCL 20A

A theory is described for predicting sonic boom pressure signatures emitted by nonlifting rectangular wings. Comparisons are made with previous (Whitham) theory and with experimentally determined near field signatures. Although both theories agree with experiment for low aspect ratio wings, Whitman's theory seriously overpredicts signature length for high aspect ratio wings. No experiments were conducted in the far field, but the two theories predict nearly identical results in this region.
Author

N72-11950*# Virginia Polytechnic Inst., Blacksburg. Dept. of Aerospace Engineering.
INVESTIGATION OF AN AIRCRAFT TRAILING VORTEX USING A TUFT GRID
W. H. Mason and J. F. Marchman, III Sep. 1971 46 p refs
(Grant NGL-47-004-067)
(NASA-CR-62077; VPI-E-71-17) Avail: NTIS CSCL 01B

With the increasing capacity of airport terminal areas, and the use of the new large jet transports, it has become important to understand the turbulent wake created by these aircraft. A study of the trailing vortex of a wing has been made using a tuft grid in a 6 foot wind tunnel. The study included an investigation of the use of mass injection at the wing tip as a means of destroying the vortex. Test results show that a fully developed, stable, vortex exists at least a distance of thirty chord lengths downstream of the wing, and that the swirl of the vortex can be reduced or eliminated by mass injection at the wing tip. Author

N72-11951*# National Aeronautics and Space Administration, Washington, D.C.
AIRCRAFT WAKE TURBULENCE AVOIDANCE
William A. McGowan Ot*awa Can. Aeron. and Space Inst. 1971 19 p refs Presented at 12th Anglo-Am. Aeron. Conf., Calgary, Can., 7-9 Jul. 1971 Backup document for AIAA Synoptic scheduled for publication in Journal of Aircraft in Mar. 1972
(NASA-TM-X-67448; Rept-72/6) Avail: NTIS CSCL 01C

Analytical studies and flight tests are used to describe the formation and severity of trailing vortices and the spatial extent of their influence. This information is then used to outline procedures for ready application by pilots, tower operators, and others concerned with the flow of traffic. The procedures provide the necessary appreciation of the physical attributes of trailing vortices, the potential hazards involved when encountering them, and how best to avoid the dangerous portions of the wake during flight operations. Author

N72-11952# Greater London Council (England).
HELICOPTER OPERATIONS AND HELIPORTS
[1971] 24 p
(S12/222) Avail: NTIS

A summary of the use of helicopters in Great Britain is presented, along with a detailed account of the Battersea heliport and its use. Particulars of helicopter operations and heliports or projected heliports in various European countries are discussed. Similar information for several countries outside western Europe is also given. The developing role of helicopters in London is considered, and the uncertainties surrounding the timing and future scale of operations is mentioned. Author

N72-11953# Social and Community Planning Research, London (England).
HELICOPTER NOISE IN CENTRAL LONDON
Jean Morton-Williams and Richard Berthoud Nov. 1970 39 p
(P-184) Avail: NTIS

An experimental situation from which to assess the possible effects of helicopters landing and taking off in the center of London, is reported. A helistop is a scaled down heliport with minimal facilities. The purpose of the experiment was to measure the noise created by the machines, and to investigate the extent to which this noise, and any other side-effects, distracted or annoyed people who lived or worked in the vicinity. The overall conclusion of this report is largely favourable to the helistop, in that not many people complained of the noise or disapproved of the use of the site. It should, however, be pointed out at this early stage that the application of this conclusion is limited. The helicopters used were small and relatively quiet; the site was rarely used; novelty value had perhaps not worn off; the area already suffered from very heavy traffic noise. Author

N72-11954# National Inst. of Law Enforcement and Criminal Justice, Washington, D.C.
THE UTILIZATION OF HELICOPTERS FOR POLICE AIR MOBILITY
Feb. 1971 96 p refs
(ICR-71-2) Avail: SOD $0.45

Uses of helicopters in the United State in support of law enforcement activities are described. Many law enforcement agencies which use helicopters were surveyed to ascertain the types of activities for which the helicopters are used. While the main emphasis continues to be on traffic surveillance, speed law enforcement, traffic control, and search and rescue activities, other types of activities are becoming increasingly evident. These growing activity areas include air evacuation, air and water pollution control, emergency cargo transportation, riot control, narcotics detection, fire fighting, night patrols for crime prevention, and covert surveillance. Also included in the survey were the types and numbers of helicopters employed, their annual utilization rates, and the types of special law enforcement-related equipment installed. Author

N72-11955*# Scientific Translation Service, Santa Barbara, Calif.
EFFECT OF SONIC BOOM ON BUILDINGS (SECOND REPORT: ELABORATION OF A METHOD FOR CALCULATING THE DEFORMATION OF CONSTRUCTIONS)
Washington NASA Dec. 1971 69 p refs Transl. into ENGLISH of the publ. "Effet du Bang sur les Batiments (2e Rapport: Elaboration d'une Method de Calcul de la Formation des Ouvrages)" Paris, Centre Sci. et Tech. du Batiment, Dec. 1970 63 p
(Contract NASw-2035)
(NASA-TT-F-14056) Avail: NTIS CSCL 20A

The acoustic response of various room configurations in buildings to sonic booms is calculated. Configurations studied include; (1) single rooms having openings in walls, (2) penetration of booms through flexible walls, (3) two rooms coupled acoustically by openings, and (4) rooms with window panes. Author

N72-11956*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DEPLOYMENT LOADS DATA FROM A FREE-FLIGHT INVESTIGATION OF ALL FLEXIBLE PARAWINGS HAVING 371.612 SQ METERS (4000 SQ FEET) OF WING AREA
Delwin R. Croom Washington Nov. 1971 510 p refs
(NASA-TM-X-2326; L-7843) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

A free-flight test program to determine the deployment characteristics of all-flexible parawings was conducted. Both

single-keel and twin-keel parawings having a wing area of 4000 square feet with a five-stage reefing system were tested by use of a bomb-type instrumented test vehicle. Several twin-keel-parawing tests were also made by using an instrumented controllable sled-type test vehicle. The systems were launched from either a C-130 or a C-119 carrier airplane, and a programer parachute was used to bring the test vehicle to a proper dynamic pressure and near-vertical flight path prior to deployment of the parawing system. The free-flight deployment loads data are presented in the form of time histories of individual suspension-line loads and total loads. Author

N72-11957*# Boeing Co., Seattle, Wash. Commercial Airplane Group.

THE EXPERIMENTAL DETERMINATION OF ATMOSPHERIC ABSORPTION FROM AIRCRAFT ACOUSTIC FLIGHT TESTS

R. L. Miller and P. B. Oncley Washington NASA Nov. 1971 107 p refs

(Contract NAS1-10272)

(NASA-CR-1891; D6-25492) Avail: NTIS CSCL 01B

A method for determining atmospheric absorption coefficients from acoustic flight test data is presented. Measurements from five series of acoustic flight tests were included in the study. The number of individual flights totaled 24: six Boeing 707 flights performed in May 1969 in connection with the turbofan nacelle modification program, eight flights from Boeing tests conducted during the same period, and 10 flights of the Boeing 747 airplane. The effects of errors in acoustic, meteorological, and aircraft performance and position measurements are discussed. Tabular data of the estimated sample variance of the data for each test are given for source directivity angles from 75 deg to 120 deg and each 1/3-octave frequency band. Graphic comparisons are made of absorption coefficients derived from ARP 866, using atmospheric profile data, with absorption coefficients determined by the experimental method described in the report. Author

N72-11958# Federal Aviation Administration, Washington, D.C. Office of Noise Abatement.

THE FEDERAL AVIATION ADMINISTRATION AIRCRAFT NOISE ABATEMENT PROGRAM, FY 1971 - 1972

William C. Sperry [1971] 54 p refs Presented at the Seminar on Noise Pollution of the Urbon Environment, Madison, Wis., 16-17 Nov. 1970

Avail: NTIS

The FAA aircraft noise abatement program is reviewed. The goals of the program and the objectives of research for noise evaluation and control are given. Itemized operational procedures for noise abatement include: takeoff procedures, approach procedures, takeoff and approach routes, cruise procedures and routes, and limiting operations. Bibliographies of FAA aircraft noise reports and environmental papers are included along with lists of FAA noise pollution and exhaust emission projects.

F.O.S.

N72-11959# Federal Aviation Administration, Washington, D.C.

GOVERNMENT'S NEEDS IN ACOUSTICS: AIRCRAFT NOISE ABATEMENT AND REGULATION

William C. Sperry 1969 28 p refs Presented at Am. Soc. for Eng. Educ. Ann. Meeting, University Park, Pa., 23-26 Jun. 1969 (Rept-61) Avail: NTIS

The United States Government's requirements in acoustics are examined from the standpoint of an agency with the responsibility for regulating aircraft noise. The airport community noise problems are delineated in terms of economic and social costs to the public and the inhibition of normal growth for an important portion of the national economy. The Government's contributions to a solution are represented as noise control research, economic analyses of the noise control potential, and noise regulations. The primary functions of the acoustical engineer are classified as research planning and management, standards preparation, committee activities, and legal coordination. His corresponding training requirements are described in detail, with emphasis on the fundamentals. Author

N72-11960# National Physical Lab., Teddington (England). Aerodynamics Div.

SCALE EFFECTS ON OSCILLATORY CONTROL-SURFACE DERIVATIVES

A. W. Moore London Aeron. Res. Council 1971 42 p refs Supersedes NPL-AERO-1283; N70-34928 01-19; ARC-31368 (ARC-CP-1151; NPL-AERO-1283; ARC-31368) Avail: NTIS; HMSO: 60p; PHI: $2.55

The limited evidence available indicates that provided boundary layer separation is not a flow feature, wind tunnel measurements of control surface derivatives should be made without fixing boundary layer transition on a model. Aerodynamic hinge moment stiffness tends to increase with Reynolds number but decreases sharply when the transition is fixed. The damping follows a similar pattern in two-dimensional tests, but with three-dimensional tests, neither an increase in Reynolds number nor fixing the boundary layer transition appears to have any significant effect. Author (ESRO)

N72-11961# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.

THE AERODYNAMIC EFFECT OF GROUND PROXIMITY ON LATERAL CONTROL OF SLENDER AIRCRAFT IN THE LANDING APPROACH

W. J. G. Pinsker London Aeron. Res. Council 1971 32 p refs Supersedes RAE-TR-70079; ARC-32340 (ARC-CP-1152; RAE-TR-70079; ARC-32340) Avail: NTIS; HMSO: 40p; PHS: $1.75

Recent wind tunnel tests revealed the existence of a powerful ground effect on the rolling derivatives of a slender wing model. Analog computer studies were made which show the consequences of this phenomenon on the lateral behavior of a large slender aircraft during landing approaches in the presence of side gusts. The ground effect is shown to exert a powerful constraint on bank angle disturbances for this class of aircraft, almost eliminating the effects of lateral turbulence as a control problem. Other possible consequences of this ground effect on various lateral control problems are briefly discussed.

Author (ESRO)

N72-11962# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.

WIND TUNNEL TESTS AT TRANSONIC AND SUPERSONIC SPEEDS TO INVESTIGATE THE LONGITUDINAL STABILITY OF A MODEL OF THE AVRO 720 AIRCRAFT

E. Huntley London Aeron. Res. Council 1971 49 p refs Supersedes RAE-TN-AERO-2685; ARC-22430 (ARC-CP-1140; RAE-TN-AERO-2685; ARC-22430) Avail: NTIS; HMSO: 40 p; BIS: $1.60

Tests were made in a 3ft x 3ft wind tunnel on a 1/30 scale model of the AVRO 720 aircraft to investigate the longitudinal stability characteristics at Mach numbers between 0.70 and 2.00. Additional tests were made with airbrakes attached to the rear-fuselage and with notches cut in the leading edges of the wing at 66.7% semispan. The results show no doubtful features apart from a sharp but small transient pitch-up at lift coefficients around C_{L} = 0.45 for M = 0.80 and C_{L} = 0.60 for M = 0.96. The instability is appreciably reduced by the application of up-elevon and is almost completely eliminated by the leading edge notches. The notches, however, introduce some instability at M = 0.99 where none had occurred originally.

Author (ESRO)

N72-11963# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

A FURTHER WIND TUNNEL INVESTIGATION OF UNDERWING JET INTERFERENCE

A. G. Kurn London Aeron. Res. Council 1971 52 p refs Supersedes Rae-TR-69090; ARC-31505 (ARC-CP-1156; RAE-TR-69090; ARC-31505) Avail: NTIS; HMSO: 70p; PHI: $2.95

Experiments, to investigate the interference of the jet

stream issuing from a high bypass ratio engine mounted below a wing are described. Tests have been made with a two-dimensional wing, and two nozzle shapes representing engines with different fan cowl lengths. A jet blowing from these nozzles produced negligible interference on the wing upper surface. However, a change in the lower surface pressure distribution occurred which was dependent only on the wing and nozzle geometry. This interference was dominated by a high suction peak, which appeared to be related to a region in the jet where the alternate expansion and compression waves were not uniformly spaced.
Author (ESRO)

N72-11964# Royal Aircraft Establishment, Bedford (England). Aero Flight Div.
THEORETICAL ASSESSMENT OF A METHOD FOR THE FLIGHT MEASUREMENT OF NET ENGINE THRUST USING TOWED DRAG DEVICES
W. J. G. Pinsker 1971 27 p refs Supersedes RAE-TR-69281; ARC-32173
(ARC-CP-1169; RAE-TR-69281; ARC-32173) Avail: NTIS; HMSO: 40p; BIS $1.60

It is shown that in theory at least engine net-thrust can be determined from flight tests utilizing towed drag devices e.g. parachutes. The thrust evaluation is based on the measurement of the pull exerted by the device on the aircraft and the speed change it produces in level flight. A knowledge of the variation of thrust and drag with speed is required, however, and the accuracy of the technique is assessed to be at best 3 to 5 per cent. There are, moreover, flight conditions and configurations where the methods are of little practical value and these are indicated. A potential accuracy of near 1% is obtainable, if the technique is used to measure the increment of thrust obtained from change of throttle at a fixed speed. This could be useful as a check on thrust measurements by other methods. Apart from this particular application, the investigated method does not appear to offer a clear advantage in accuracy over existing procedures, but it might be used where simplicity is more important than high accuracy or where other methods are impracticable for some specific reasons. Author (ESRO)

N72-11965# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
AIRCRAFT CENTRE OF GRAVITY RESPONSE TO TWO-DIMENSIONAL SPECTRA OF TURBULENCE
I. W. Kaynes London Aeron. Res. Council 1971 37 p refs Supersedes RAE-TR-69271; ARC-32139
(ARC-R/M-3665; RAE-TR-69271; ARC-32139) Avail: NTIS; HMSO: 90p; BIS: $3.50

The energy spectrum of atmospheric turbulence is used to predict the normal acceleration response of a rigid aircraft. Particular reference is made to spanwise variations of gust velocity and this effect is described in terms of a general input spectrum which is applicable to any wing with a particular spanwise loading distribution operating under a wide range of conditions. Tables of the gust response factor and the number of zero crossings are presented for a range of parameters.
Author (ESRO)

N72-11966# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
FURTHER PILOTED SIMULATION STUDIES OF THE HANDLING CHARACTERISTICS OF A SLENDER-WING SUPERSONIC TRANSPORT AIRCRAFT DURING APPROACH AND LANDING
B. N. Tomlinson London Aeron. Res. Council 1971 54 p refs Supersedes RAE-TR-69003; ARC-31375
(ARC-R&M-3660) Avail: NTIS; HMSO: £1.40; PHI: $5.80

A simulated slender wing supersonic transport aircraft was flown by a number of airline and test pilots. Pilots, comments on the handling qualities of the simulated aircraft, problem areas, and touchdown, and the effect of autostabilizer failures were studied. The touchdown phase was of particular interest. Results were qualified by the inability of the simulation to provide all the cues, particularly visual ones, necessary for a successful landing. Cockpit motion in pitch and roll was used. Principal results were that 1) The handling qualities of the simulated aircraft in its fully autostabilized state were good; 2) Loss of the pitch damper provoked the strongest criticisms; and 3) Loss of autothrottle did not pose any great difficulty. Retaining the autothrottle in operation throughout the landing flare was desirable. Sidestep maneuvers were performed easily and good landings could be made in calm and turbulent conditions, in cross winds up to 25 kts.
Author (ESRO)

N72-11967# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
LOW-SPEED WIND-TUNNEL MEASUREMENTS OF SURFACE PRESSURE FLUCTUATIONS ON TWO SLENDER-WING MODELS
D. A. Lovel and T. B. Owen London Aeron. Res. Council 1971 43 p refs Supersedes RAE-TR-70168; ARC-32575
(ARC-CP-1154; RAE-TR-70168; ARC-32575) Avail: NTIS; HMSO: 60p; PHI: $2.65

Measurements of the amplitudes and spectra of surface pressure fluctuations have been made on the upper surfaces of two delta wings with 76 deg leading-edge sweep. The high frequency portion of each spectrum is found to conform to a universal scaling law based on two-dimensional boundary-layer data. It is also found that the high level of low-frequency pressure fluctuations is confined to an area on the upper surface of the wing under and outboard of the core of the leading-edge vortex sheet and that the amplitudes and spectrum shapes of the low-frequency portions of the spectra are not strongly dependent on the Reynolds number, and the nondimensional magnitude increases slowly with increasing angle of incidence. However, the high level of low-frequency fluctuations spreads inboard as the angle of incidence is increased and problems of wing buffet or panel vibration could arise on a large aircraft. Author

N72-11968# Naval Air Development Center, Johnsville, Pa.
STATISTICAL REVIEW OF COUNTING ACCELEROMETER DATA FOR NAVY AND MARINE FLEET AIRCRAFT Summary Report, 1 Jan. 1962 - 1 Jan. 1971
Thomas A. DeFiore 1 May 1971 108 p ref
(AD-725840; NADC-ST-7108) Avail: NTIS CSCL 01/3

The report is a specialized summary of normal acceleration data recorded by counting accelerometers. Data are separated by calendar time and mission category. Only data reported in the counting accelerometer program are included. Author (GRA)

N72-11969# North American Rockwell Corp., Los Angeles, Calif.
AERODYNAMIC STABILITY AND CONTROL/WIND TUNNEL DATA CORRELATION Final Technical Report, 15 Oct. 1966 - 31 Aug. 1970
G. R. Casteel May 1971 220 p refs
(Contract AF 33(615)-5323; AF Proj. 698 BT)
(AD-726103; NA-70-327-2; AFFDL-TR-71-3) Avail: NTIS CSCL 01/3

The general objective was to collect and analyze aerodynamic stability and control data for the XV-4B, XV-5A, and P-1127 VTOL configurations. Correlation and analysis of existing model data were made to investigate hover and transition characteristics. Particular emphasis was placed on the aerodynamic power effects, sometimes referred to as interference effects. Other areas of investigation were sometimes referred to as interference effects. Other areas of investigation were nondimensional coefficients used to present VTOL data and wind tunnel test techniques. Wind tunnel tests were conducted using an inlet only model and a jet only model to investigate special test and analysis problems for these components. The agreement between different sets of XV-4B model data was, in general, found to be poor. However, the nondimensional coefficients used by Lockheed to reduce to XV-4B model data appear to be valid parameters for this category of VTOL airplane. The jet entrainment flow was shown by experiment to be the primary cause of the XV-4B

power effects, and the XV-4B jet path was experimentally and theoretically determined. Author (GRA)

N72-11970# Army Foreign Science and Technology Center, Charlottesville, Va.
TOLERANCE PLUS OR MINUS 5: HOW TO UNDERSTAND IT /?/
N. Chernykh, B. A. Andreeva, and V. Lysova 21 Jul. 1971 11 p Transl. into ENGLISH from Aviatsiya i Kosmonavtika (Moscow)
(AD-728656; FSTC-HT-23-741-71) Avail: NTIS CSCL 01/3

Statistical evaluation of regular periodic service of aircraft as a function of accrued flying time is presented. GRA

N72-11971# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.
THEORY OF AN AIR CUSHION LANDING SYSTEM FOR AIRCRAFT Technical Report, Aug. 1968 - Jun. 1971
Kennerly H. Digges Jun. 1971 327 p refs
(AF Proj. 1369)
(AD-728647; AFFDL-TR-71-50) Avail: NTIS HC $6.00/MF $0.95 CSCL 01/3

The Air Cushion Landing System is a scheme to replace the wheeled landing gear on aircraft by a peripheral jet air cushion. The concept employs a flexible elastic membrane or 'trunk' which is attached to the bottom of the aircraft fuselage. During flight, the trunk shrinks elastically and hugs the bottom of the fuselage like a de-icing boot. When a flow of air is applied to tye inside of the trunk, the elastic material stretches and forms an elongated doughnut-shaped protrusion on the underside of the aircraft. The air flow is ducted by the trunk to the fuselage periphery and exhausted through a large number of holes or slots. As a result, a pressure builds up under the aircraft when the ground is approached. The pressure is sufficient to support the aircraft and absorb its vertical landing velocity. The study develops analytical relationships between the variables associated with the Air Cushion Landing System. Included are the following: The derivation of a theory which predicts the static characteristics of the system; Analytical methods for predicting flow, jet height and power requirements; Curves which illustrate the inter-relationships among the design variables; Computer programs for predicting the cross-sectional area and shape of the elastic trunk; The development and test of an analytical model which predicts the dynamic response of the system to landing impact; A discussion of the design considerations for the system.
Author (GRA)

N72-11972# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
INTERNAL/EXTERNAL NOISE Final Report
10 Jun. 1971 12 p refs
(AMCR Proj. 310-6)
(AD-728454; MTP-7-3-5) Avail: NTIS CSCL 01/3

Procedures are given to be used to determine that Army aircraft, equipment, auxiliary systems and air traffic control facilities are in accord with the internal/external noise limitations stated in Materiel Needs and the suitability of these items for Army use. Author (GRA)

N72-11973# California Univ., Los Angeles. School of Engineering and Applied Science.
ON THE PREDICTION AND OPTIMALITY OF AIRCRAFT MANEUVERS ASSOCIATED WITH APPROACH AND LANDING
Glenn Dexter Buell, Jr. Jun. 1971 161 p refs
(Contract F04701-70-C-0240; Grant AF-AFOSR-0699-67; AF Proj. 9749)
(AD-728325; UCLA-ENG-7126; AFOSR-71-2266TR; Task-61102f; Task-681304) Avail: NTIS CSCL 01/3

The report analyzes in detail two of the critical aircraft maneuvers associated with approach and landing; the go-around maneuver and the flare maneuver. Optimal solutions that include state and control variable constraints are obtained for both problems. Two algorithms are given for computation of the minimum and maximum altitude loss associated with the pilot controlled go-around maneuver. A matrix operator is obtained that can be used for inflight computation of the altitude loss on a small general purpose digital computer. The flare optimization presented is for a cost functional that includes both the longitudinal touchdown dispersion and the normal acceleration. A closed loop mechanization is given that approximates the optimal trajectory. A second matrix operator which can be used for prediction of the longitudinal touch down point is obtained. Uncertainties are also obtained for the purpose of establishing a prediction confidence level. It is proposed that these prediction techniques should be incorporated into a decision making performance monitor. This monitor could provide the pilot with a continuous assessment of the approach and could generate a pre-flare decision on whether or not to commit the aircraft to the flare maneuver. Author (GRA)

N72-11974# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
AN INVESTIGATION OF AIRBORNE DISPLAYS AND CONTROLS FOR SEARCH AND RESCUE (SAR). VOLUME 3: AVIONICS ANALYSIS AND SYSTEM SYNTHESIS Final Report, 30 Jun. 1969 - 1 Dec. 1970
O. Herbert Lindquist, Arthur L. Jones, and James W. Wingert Jul. 1971 331 p refs
(Contract N00014-69-C-0460; NR Proj. 213-072)
(AD-728043; Rept-12609-FR1-Vol-3; JANAIR-701221-Vol-3) Avail: NTIS HC $6.00/MF $0.95 CSCL 06/7

The analysis and synthesis of an avionics system for a search and rescue mission must take into account the constraints imposed by the aircraft along with the requirements imposed by the mission and the avionic equipment available as described in Volume II. For this purpose an estimate of the helicopter size and operational characteristics required for the 1972-1974 SAR missions was made. These characteristics are presented. In the study the crew workload analyses and the system synthesis were cycled through twice, once for a baseline system and once for a revised system. Prior to the start of the second crew workload analysis, the number of crew members was reduced from five to four, necessitating a redistribution of functions among the crew. Furthermore, the results of the first analyses indicated that a detailed investigation of the flight control system was required to define the required modes and associated workloads.
Author (GRA)

N72-11975# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
AN INVESTIGATION OF AIRBORNE DISPLAYS AND CONTROLS FOR SEARCH AND RESCUE (SAR). VOLUME 1: SUMMARY Final Report, 30 Jun. 1969 - 1 Dec. 1970
O. Herbert Lindquist, Arthur L. Jones, and James W. Wingert Jul. 1971 44 p
(Contract N00014-69-C-0460; NR Proj. 213-072)
(AD-728041; HONEYWELL-12609-FR1-Vol-1; JANAIR-701219) Avail: NTIS CSCL 06/7

An analytical synthesis and evaluation of an avionic system and its airborne displays and controls was performed for a hypothetical Search and Rescue helicopter of the 1972-1974 era. The requirements for the system were based on composite mission and operational requirements obtained from four services: U.S. Navy, U.S. Air Force, U.S. Army and U.S. Coast Guard. The candidate systems evaluated were selected from equipment that was state of the art now or readily could be by 1972. The evaluations of the candidate systems were based on the functional performance of the equipment and on the crew-equipment interface suitability as measured by crew workload. The configuration recommended met most, but not all, of the composite mission requirements. Additional development was suggested in areas where the equipment or the crew-equipment interface evaluations indicated a deficiency in performance. Author (GRA)

N72-11976# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
AN INVESTIGATION OF AIRBORNE DISPLAYS AND CONTROLS FOR SEARCH AND RESCUE (SAR). VOLUME 2: SAR REQUIREMENTS AND TECHNOLOGY SURVEY Final Report, 30 Jun. 1969 - 1 Dec. 1970
O. Herbert Lindquist, Arthur L. Jones, and James W. Wingert Jul. 1971 183 p refs
(Contract N00014-69-C-0460; NR Proj. 213-072)
(AD-728042; HONEYWELL-12601-FRI-Vol-2; JANAIR-701220) Avail: NTIS CSCL 06/7

The volume covers the initial work tasks of this multiservice (USN, USA, USAF, USCG) research effort which pertains to airborne displays and controls for search and rescue vehicles for the 1972-1974 time frame. The work tasks include collection of SAR mission objectives from the four services, description of flight mission profiles by mission segments, identification of functional requirements to be met and technology surveys of industry to determine applicable avionics capabilities.
Author (GRA)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N72-11977*# Bureau of Mines, Pittsburgh, Pa. Energy Research Center.
DIELECTRIC PROPERTIES OF BATTERY ELECTROLYTES Final Report A-1
[1971] 76 p refs
(NASA Order WO-6085)
(NASA-CR-124617) Avail: NTIS CSCL 10C

An effort was made to determine the effects of electromagnetic radiation on the terminal properties of electrochemical cells. Various constituents of the battery were measured to determine basic electromagnetic properties. These properties were used to predict how much radiation would be absorbed by a battery in a particular field configuration. The frequency range covered from 0 to 40 GHz with the greatest emphasis on the microwave range from 2.6 to 40 GHz. The measurements were made on NiCd, AgZn, and Pb acid cells. Results from observation show nothing which suggested any interaction between radiation and cells, and no incidence of any peaks of energy absorption was observed. Author

N72-11978*# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs.
DESIGN AND FABRICATION OF BRAYTON CYCLE SOLAR HEAT RECEIVER Final Report
I. Mendelson, (ed.) Jul. 1971 329 p refs
(Contract NAS3-10944)
(NASA-CR-72872 GESP-519) Avail: NTIS HC $6.00/MF $0.95 CSCL 10C

A detail design and fabrication of a solar heat receiver using lithium fluoride as the heat storage material was completed. A gas flow analysis was performed to achieve uniform flow distribution within overall pressure drop limitations. Structural analyses and allowable design criteria were developed for anticipated environments such as launch, pressure containment, and thermal cycling. A complete heat receiver assembly was fabricated almost entirely from the refractory alloy, niobium-1% zirconium.

N72-11979# Royal Aircraft Establishment, Farnborough (England).
COMPARATIVE ASSESSMENT OF TWO FORMS OF CYCLOCONVERTER
A. Bainbridge May 1970 47 p refs
(RAE-TR-70092; EP-547; UDC-621.314.26) Avail: NTIS

The operation of two forms of cycloconverter, using natural and forced commutation, is described and analysed mathematically, with particular reference to equivalent circuit parameters, effective power factor and harmonic content. It has been claimed that the differences between these alternatives will have significant effects on the performance and engineering arrangement of variable speed constant frequency (VSCF) aircraft generating systems, and the analysis confirms that forced commutation has theoretical advantages which could result in simplified circuitry and reduced size of alternator. The results presented which admittedly apply to ideal situations, will help in the assessment of the two systems and indicate further avenues of research.
Author

N72-11980*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A PARAMETRIC STUDY OF MOTOR STARTING FOR A 2- TO 10-KILOWATT BRAYTON POWER SYSTEM
Dennis A. Cantoni Washington Nov. 1971 20 p refs
(NASA-TM-X-2432; E-6548) Avail: NTIS CSCL 10A

A study of the motor starting of a Brayton cycle power system was conducted to provide estimates of system sensitivity to several controllable parameters. These sensitivity estimates were used as a basis for selection of an optimum motor-start scheme to be implemented on the 2- to 10-kilowatt Brayton power system designed and presently under test. The studies were conducted with an analog simulation of the Brayton power system and covered a range of frequencies from 400 Hz (33 percent design) to 1200 Hz (design), voltage-to-frequency ratios of 0.050 (50 percent design) to 0.100 (design), turbine-inlet temperatures of 800 K (1440 R, 70 percent design) to 1140 K (2060 deg R, design), and prestart pressure levels of 14.5 psia to 29.0 psia. These studies have shown the effect of selected system variables on motor starting. The final selection of motor-start variables can therefore be made on the basis of motor-start inverter complexity, battery size and weight, desired steady-state pressure level after startup, and other operational limitations. In general, the study showed the time required for motor starting to be inversely proportiofal to motor frequency, voltage, turbine-inlet temperature, and pressure level. An increase in any of these parameters decreases startup time. Author

N72-11981*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TECHNOLOGY OF NUCLEAR-BRAYTON SPACE POWER SYSTEMS
Robert E. English [1971] 27 p refs Presented at the 1971 Am. Nucl. Soc. Meeting, Miami, Fla., 17-21 Oct. 1971
(NASA-TM-X-67957) Avail: NTIS CSCL 10A

The present technology of Brayton power systems is reviewed. The potential for even higher system efficiency at the 10 KWe level is assessed as well as the potential for comparable efficiency with an output of 1 or 2 KWe. Systems accommodation of isotope decay is briefly discussed. The salient features are described for a Brayton power system based on this technology and employing the ZrH reactor. Reactor lives for this and competitive systems are compared. Growth capability with an advanced reactor is assessed. A concept for application of this technology to driving a gas-dynamic laser is described.
Author

N72-11982*# TRW Systems Group, Redondo Beach, Calif.
THE 20 kW BATTERY STUDY PROGRAM Final Report
30 Jul. 1971 421 p refs
(Contract NAS5-21066)
(NASA-CR-122296; TRW-13837-6001-R0-00) Avail: NTIS HC $6.00/MF $0.95 CSCL 10C

Six battery configurations were selected for detailed study and these are described. A computer program was modified for use in estimation of the weights, costs, and reliabilities of each

of the configurations, as a function of several important independent variables, such as system voltage, battery voltage ratio (battery voltage/bus voltage), and the number of parallel units into which each of the components of the power subsystem was divided. The computer program was used to develop the relationship between the independent variables alone and in combination, and the dependent variables: weight, cost, and availability. Parametric data, including power loss curves, are given. Author

N72-11983*# Martin Marietta Corp., Denver, Colo.
DESIGN, DEVELOPMENT, MANUFACTURE, TESTING, AND DELIVERY OF DEVICES FOR CONNECTION OF SOLAR CELL PANEL CIRCUITRY TO FLAT CONDUCTOR CABLE SOLAR CELL ARRAY HARNESS Final Summary Report
P. A. Dillard and D. Waddington Oct. 1971 141 p ref
(Contract NAS8-26114)
(NASA-CR-121049; MCR-71-256) Avail: NTIS CSCL 10A

The technology status and problem areas which exist for the application of flat conductor cabling to solar cell arrays are summarized. Details covering the design, connector manufacture, and prototype test results are also summarized. E.H.W.

N72-11984*# Texas Technological Univ., Lubbock. Dept. of Geoscience.
MARTIAN ENVIRONMENTAL EFFECTS ON SOLAR CELLS AND SOLAR CELL COVER GLASSES Final Report
F. Alton Wade 1 Aug. 1971 103 p refs Prepared for JPL
(Contract NAS7-100; JPL-952582)
(NASA-CR-124630; TTU-3101) Avail: NTIS CSCL 10A

The results of a study concerned with the effects of the Martian environment on the performance of solar cells are given. The results indicate that the efficiency of a power system composed of solar cells will be greatly reduced when subjected to dust storms such as may occur on Mars. Two factors are responsible for this, (1) accumulation of dust on the protective covers, and (2) damage to covers by pitting, cracking, and chipping. It is recommended that this type of power system not be used on Mars landing vehicles. Experimental procedures are described and results are summarized and damage assessed.
Author

N72-11985*# Idaho State Univ., Pocatello. Dept. of Chemistry.
INVESTIGATION OF ELECTRODE MATERIALS FOR ALKALINE BATTERIES Final Report
G. Myron Arcand 15 Nov. 1971 81 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952265)
(NASA-CR-124631) Avail: NTIS CSCL 10C

A number of amalgam electrode systems were investigated xor possible use as high rate anodes and cathodes. The systems examined include: lithium, sodium, and potassium in Group 1, magnesium, calcium, and barium in Group 2, aluminum in Group 3, lead in Group 4, copper in Group 1b, and zinc and cadmium in Group 2b. The K(Hg) and Na(Hg) anodes in 10 VF and 15 VF (an unambiguous expression of concentration that indicates the number of formula weights of solute dissolved in a liter of solution) hydroxide solutions have proven satisfactory; some of these have produced current densities of more than 8 A/sq cm. None of the amalgam cathodes have approached this performance although the Tl(Hg) has delivered 1 A/sq cm. Se(Hg) and Te(Hg) cathodes have given very stable discharges. Zn(Hg) and Cd(Hg) electrodes did not show good high rate characteristics, 200 to 300 mA/sq cm being about the maximum current densities obtainable. Both amodes are charged through a two-step process in which M(Hg) is first formed electrochemically and subsequently reduces Zn(II or Cd(II) to form the corresponding amalgam. The second step is extremely rapid for zinc and very slow for cadmium. Author

N72-11986*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SUBSYSTEM RADIATION SUSCEPTIBILITY ANALYSIS FOR DEEP-SPACE MISSIONS
Wm. S. West, W. Poch, A. Holmes-Siedle, H. W. Bilsky, and D. Carroll Washington Nov. 1971 179 p refs
(NASA-TR-R-371; G-1029) Avail: NTIS CSCL 10A

Scientific, unmanned spacecraft on mission to Jupiter and beyond will be subjected to nuclear radiation from the natural environment and onboard nuclear power sources which may be harmful to subsystems. This report postulates these environments and discusses practical considerations to ensure confidence that the spacecraft's materials and subsystems will withstand the effects of anticipated radiation. Degradation mechanisms are discussed. Author

N72-11987*# Boeing Co., Seattle, Wash.
INTEGRATED THIN FILM CADMIUM SULFIDE SOLAR CELL MODULE Final Report
R. A. Mickelsen and D. D. Abbott Nov. 1971 88 p refs
(Contract NAS3-13232)
(NASA-CR-120812; D180-10302-2) Avail: NTIS CSCL 10B

The design, development, fabrication and tests of flexible integrated thin-film cadmium sulfide solar cells and modules are discussed. The development of low cost and high production rate methods for interconnecting cells into large solar arrays is described. Chromium thin films were applied extensively in the deposited cell structures as a means to: (1) achieve high adherence between the cadmium sulfide films and the vacuum-metallized copper substrates, (2) obtain an ohmic contact to the cadmium sulfide films, and (3) improve the adherence of gold films as grids or contact areas. Author

N72-11988# Atomics International, Canoga Park, Calif.
INTERHALOGEN CELLS Final Report, 20 Apr. 1970 21 Mar. 1971
M. M. Nicholson and M. L. Iverson Jun. 1971 67 p refs
(Contract N00019-70-C-0376)
(AD-728047; AI-71-15) Avail: NTIS CSCL 10/3

The development of a chlorine trifluoride battery cathode in anhydrous hydrogen fluoride was continued in this program, and the feasibility of a lithium alloy anode in the same solvent was investigated. As a current collector for the cathode system, platinum was far superior to nickel, copper, aluminum, or boron carbide. The cathode process on platinum was characterized in some detail by voltammetric measurements on solutions of ClF3, Cl2, ClF, and mixtures thereof. It was concluded that the ClF3 system lacks adequate recharge capability for secondary battery applications, although pt is a very active primary cathode. Lithium-aluminum and lithium-magnesium alloys ranging in formal compositions from Li9Al to LiAl2 and Li2Mg to LiMg2 were examined for chemical compatibility with a 1 M LiF-HF electrolyte and for amodic reactivity in the same medium. Lithium alloys thus show definite promise as anodes for reserve cells in HF. From the results an Li alloy-ClF3 cell in HF is expected to perform as a high-energy, high-rate primary power source at low temperatures. Author (GRA)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N72-11989# Joint Publications Research Service, Washington, D.C.
SPACE BIOLOGY AND MEDICINE, VOLUME 5, NO. 4, 1971
O. G. Gazenko, ed. 3 Nov. 1971 144 p refs Transl. into ENGLISH of the Journal Kosmicheskaya Biol. Med., Moscow, Meditsina Publishing House, v. 5, no. 4, 1971 p 3-88
(JPRS-54396) Avail: NTIS

Papers are presented on the physiological effects of

spacecraft environmental conditions on humans and biological problems. Emphasis is on hypokinesia, acceleration stresses, and medical and nutritional problems. For individual titles, see N72-11990 through N72-12010.

N72-11990# Joint Publications Research Service, Washington, D.C.
EFFECT OF HYPODYNAMIA ON GAS EXCHANGE IN ANIMALS
Ye. A. Kovalenko, V. L. Popkov, E. S. Mailyan, Yu. S. Galushko, N. V. Gordeycheva, Yu. I. Kondratyev, N. A. Ilyushko, A. N. Poptapov, L. N. Grinberg, and M. A. Seydametov *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 1-8 refs (See N72-11989 03-04)
Avail: NTIS

The pathogenesis of prolonged hypokinesia was investigated. On the 120th day of hypokinesia, functional tests were performed to determine work capacity and acute hypoxia tolerance of animals. During an exposure to 60-day hypokinesia the dogs showed a decrease in gas exchange which was most clearly pronounced by the 30th day. By the end of the experiment gas exchange increased and immediately returned to a normal level after the experiment. Rats exposed to a longer hypokinesia exhibited a distinct acceleration of gas exchange and regional oxygen consumption in muscles by the 90th-100th day. Changes in the oxidative processes in tissues were found during the 30th-60th day of hypokinesia. The rats also revealed substantial weight losses due to a decrease in muscle mass and a noticeable loss in their capacity for performing muscular work. Their tolerance to an altitude test remained unchanged. Author

N72-11991# Joint Publications Research Service, Washington, D.C.
EFFECT OF MONOSACCHARIDES ON THE REACTION OF CONDENSATION OF FORMALDEHYDE INTO CARBOHYDRATES **c06**
V. A. Uspenskaya, O. V. Krylov, and Yu. Ye. Sinyak *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 9-18 refs (See N72-11989 03-04)
Avail: NTIS

The effect of monosaccharides of different structure on the catalytic synthesis of carbohydrates from formaldehyde was investigated. Monosaccharides with the least number of carbon atoms and monosaccharides containing keto groups were shown to have the highest capacity as cocatalysts of the synthesis. Optimal activity for arabinose, fructose, and glucose was found. According to chromatographic data, use of monosaccharides as cocatalysts brought about no difference in the chemical composition of synthetic carbohydrates. An equation describing the effect of the concentration of an organic cocatalyst on the rate of formaldehyde condensation to carbohydrates is derived.
Author

N72-11992# Joint Publications Research Service, Washington, D.C.
CHANGES IN THE ACTIVITY OF ASPARTATE AMINOTRANSFERASE AND MITOCHONDRIAL MEMBRANES IN RESPONSE TO ACCELERATIONS
L. A. Rubaskina and I. D. Yertanov *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 19-26 refs (See N72-11989 03-04)
Avail: NTIS

It was found that the activity of aspartate aminotransferase in the serum of humans exposed to transverse accelerations of 12 g for 35 sec and rats centrifuged at 36 g for six minutes decreased. During exposures of lesser intensity the value increased. The changes in enzymic activity of liver homogenate fractions of animals gave zvidence that aspartate aminotransferase molecules may pass from mitochondrial membranes into the blood stream during exposures to accelerations up to 25 g for six minutes and remain fixed to them during exposures up to 36 g. Author

N72-11993# Joint Publications Research Service, Washington, D.C.
GROUP METHOD FOR ANALYSIS OF IMPURITIES IN REGENERATED WATER **c06**
V. A. Kryuchkov *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 27-34 refs (See N72-11989 03-04)
Avail: NTIS

The composition of impurities which may contaminate water reclaimed from human liquid wastes is analyzed. The reclamation procedure, composition of contaminants, and methods for the consumption of reclaimed water are shown to disagree with standard norms. Criteria for appraising the quality of reclaimed water are formulated and a method for estimating total contamination of reclaimed water based on group parameters is devised. Application of the method in assessing the quality of reclaimed water is described, and problems related to water regeneration are discussed. Author

N72-11994# Joint Publications Research Service, Washington, D.C.
STUDY OF STREPTOCOCCAL FLORA OF THE HUMAN PHARYNX IN ISOLATED HUMAN SUBJECTS
V. I. Drozdova, R. V. Petrov, and V. M. Shilov *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 35-39 refs (See N72-11989 03-04)
Avail: NTIS

Streptococcal flora transfer between subjects during a 15-day isolation was studied. Confinement in a small enclosed volume was characterized by microbial transfer from one man to another. The test subjects exhibited no significant changes in antihyaluronidase and anti-o-streptolysine titers during the experiment. Author

N72-11995# Joint Publications Research Service, Washington, D.C.
PROVIDING RADIATION FLIGHT SAFETY FOR THE SOYUZ-9 SPACESHIP CREW **c05**
Ye. I. Vorobyev, I. V. Getselev, Yu. G. Grigoryev, V. I. Yefimov, N. S. Zatsepa, Ye. Ye. Kovalev, M. D. Nikitin, V. N. Obridko, V. M. Petrov, M. V. Teltsov et al *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 40-44 refs (See N72-11989 03-04)
Avail: NTIS

The radiation monitoring activities in preparation for and during the Soyuz 9 flight are described. Solar radiation, bursts, flares, and sunspots, and cosmic ray radiation were observed. The dosimetry was performed onboard the spaceship and also by the earth satellite Molniya 1. The total dose of cosmic radiation in the spacecraft was 195 Mrad with a dose intensity of 11 Mrad/day. N.E.N.

N72-11996# Joint Publications Research Service, Washington, D.C.
RELATIONSHIP BETWEEN THE THRESHOLDS OF CUPULAR ENDOLYMPHATIC SYSTEM RESPONSE AND MANS TOLERANCE TO MOTION SICKNESS
B. I. Polyakov and A. D. Matveyev *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 45-52 refs (See N72-11989 03-04)
Avail: NTIS

Response thresholds to angular and Coriolis accelerations (as evidenced by illusory sensations and nystagmus) to 65 test subjects were compared with their tolerances to repeated exposures to Coriolis accelerations of special configuration. The correlation coefficients between the threshold of response to Coriolis accelerations as evaluated from nystagmus and tolerance to accumulated Coriolis accelerations was 0.306 ($P > 0.95$). Mean values of response thresholds of test subjects with different tolerances to accumulated Coriolis accelerations could not be reliably discriminated. The results give evidence that data on the thresholds of cupular-endolymphatic response are of low prognostic significance with respect to human motion sickness tolerance. They also indicate a need for differentiating the

concepts of vestibular excitation and vestibular tolerance when making professional screenings of cosmonaut candidates.
Author

N72-11997# Joint Publications Research Service, Washington, D.C.
STUDY OF SELECTIVITY IN ADAPTATION TO CORIOLIS AND LINEAR ACCELERATIONS
B. B. Bokhov, V. P. Baranova, and A. A. Guyev *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 53-58 refs (See N72-11989 03-04)
Avail: NTIS

The effect of habituation to one of three tests (including Coriolis and linear accelerations) on tolerance to the other two was studied. The experiments revealed a nonspecific increase in tolerance to those tests to which no adjustment was acquired.
Author

N72-11998# Joint Publications Research Service, Washington, D.C.
STUDY OF OPTIC FUNCTIONS AND RETINAL CIRCULATION IN MAN EXPOSED TO COMPLEX ACCELERATIONS
E. S. Kotova, L. A. Kitayev-Smyk, and B. V. Ustyushin *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 59-66 refs (See N72-11989 03-04)
Avail: NTIS

Retinal hemodynamics and optic functions in 30 healthy test subjects were exposed to accelerations of 12 to 72 deg/sev. The tone of retinal vessels revealed regular changes which included variations in diastolic pressure in the central artery and changes in the caliber of arteries and veins in dependence on the duration and intensity of accelerations, as well as on the level of adaptive processes. Optic functions proved to be sufficiently stable. The results show that retinal circulation, which to a certain extent reflects the state of cerebral circulation, may be used as a criterion of the effect of Coriolis accelerations on the human body.
Author

N72-11999# Joint Publications Research Service, Washington, D.C.
EFFECT OF HIGH BRIGHTNESSES ON THE RATE OF EYE ADAPTATION TO DARKNESS
V. I. Kartsev *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 67-70 refs (See N72-11989 03-04)
Avail: NTIS

The rate of adaptation of central vision of both eyes to the darkness after light exposures of various durations (1.5, 3, 6 minutes) with illumination of 20,000 to 80,000 lux was ytudied in four test subjects in the age group 18-30. A white barium screen illuminated by direct sunlight was used as a light source. During adaptation to the darkness the central vision response time was proportional to the quantity of illumination during disadaptation. A value of approximately 8 million lux-sec was used. Central vision response remained virtually unchanged with a further stimulus increase.
Author

N72-12000# Joint Publications Research Service, Washington, D.C.
DYNAMICS OF MINUTE BLOOD VOLUME DURING PROLONGED HYPOKINESIA AS ESTIMATED BY THE ACETYLENE METHOD
G. P. Zvonarev *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 71-76 refs (See N72-11989 03-04)
Avail: NTIS

The minute blood volume of six healthy male test subjects was studied by the Grohlmann acetylene method. By the end of the bedrest experiment the minute volume had declined significantly for all the test subjects. In comparision with the test subjects who performed physical exercises during the experiment, the test subjects exposed to complete hypokinesia exhibited a greater (threefold) decrease in minute and stroke volume. The mechanism underlying the decrease in stroke volume is unrelated to pulse rate variations. It appears to be related to changes in the cardiac contraction phases, blood flow velocity and circulating blood volume. The minute volume decrease came about with a decrease in oxygen consumption in the subjects exposed to maximum hypokinesia and an increase in the arteriovenous difference in the test subjects who were allowed physical exercises.
Author

N72-12001# Joint Publications Research Service, Washington, D.C.
EXTERNAL RESPIRATION AND GAS EXCHANGE DURING A PASSIVE ORTHOSTATIC TEST
B. S. Katkovskiy *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 77-84 refs (See N72-11989 03-04)
Avail: NTIS

Most parameters of exhalation and gas exchange, which were measured during 33 orthostatic tests involving 30 minutes standing, varied significantly. Causes of hyperventilation and exhalation lag with subsequent changes of respiratory frequency and depth are discussed as factors responsible for the lack of significant changes in some external respiration parameters. The necessity of registering external respiration and gas exchange during orthostatic tests is emphasized for clarifying the mechanisms underlying the homeostasis maintained when man is in an erect position. The need for registering the CO2 percentage content in healthy and sick people during orthostatic tests is also stressed because its drastic decline is indicative of a syncope.
Author

N72-12002# Joint Publications Research Service, Washington, D.C.
HYPODYNAMIA AND HORMONAL ACTIVITY
I. V. Fedorov *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 85-89 refs (See N72-11989 03-04)
Avail: NTIS

Data in the literature on changes in the production of hormones (corticosteroids, adrenalin, adrenocorticotrophic hormone, antidiuretic hormones, and 5-hydroxyindolacetic acid) during hypodynamia are reviewed. Potential results of changes in hormonal activity are discussed.
Author

N72-12003# Joint Publications Research Service, Washington, D.C.
ODORIMETRIC EVALUATION OF POLYMERS USED IN CONSTRUCTING ISOLATION CHAMBERS c05
O. N. Shevkun, E. I. Semenenko, Ye. I. Kosterina, and G. A. Gaziyev *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 90-96 refs (See N72-11989 03-04)
Avail: NTIS

Methods for determining odor thresholds by dynamic and static techniques are described, and it is found that the modified static method is advantageous. Experimental data are given on odorimetric and chemical investigations of polymers and lacquer-stain coats indicating the relationship between the odor level and the concentration of toxic compounds in the gaseous phase. It is recommended that the method be used for screening polymers and selecting the materials with the best hygienic properties.
Author

N72-12004# Joint Publications Research Service, Washington, D.C.
DETERMINING MICROELEMENTS IN HUMAN FOOD RATIONS AND EXCRETA USING THE EXTRACTION METHOD
Ye. I. Pokrovskaya, O. G. Puzanova, and A. P. Tereshchenko *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 97-102 refs (See N72-11989 03-04)
Avail: NTIS

An analytical method is described which was used in studying the elimination of microelements by subjects eating a diet of dehydrated foods during a year of confinement in an isolation chamber. A mixture of hexamethylene ammonium

reagents and 8-oxychinoline and a mixture of solvents, chloroform, and isobutyl alcohol were used. The optimum ratios and pH of the mixtures are given for the different trace metals. N.E.N.

N72-12005# Joint Publications Research Service, Washington, D.C.
METHOD FOR DETERMINING SEROTONIN (5-HYDROXYTRYPTAMINE) IN THE INTACT BLOOD OF RATS
Z. S. Dolgun, S. P. Novikova, and V. S. Shashkov *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 103-105 refs (See N72-11989 03-04)
Avail: NTIS

A method is presented for determining the blood 5-HT, using acidic butanol in the first stage of extraction. A clean quartz vessel is used for collecting blood and precipitating proteins. The sensitivity of the procedure is 0.01, the accuracy is 5, and the return of the added serotonin is 94% to 98%. N.E.N.

N72-12006# Joint publications Research Service, Washington, D.C.
METHOD FOR PROCESSING MUSCLE BIOPOTENTIALS FOR INPUT INTO AN ELECTRONIC COMPUTER
V. N. Zhishko, A. A. Ignatov, V. D. Lovitskiy, B. N. Sorokin, and I. S. Shadrintsev *In its* Space biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 106-112 refs (See N72-11989 03-04)
Avail: NTIS

Instrumentation for isolating the most important characteristics of muscle biopotentials and representing the results in a form convenient for the computer is described. For each of the electromyograms there is an amplitude channel, a frequency channel, and a general synchronism channel. For each electromyosignal (EMS) two series of impulses are obtained, one in the 10 to 300 Hz and one in the 300 to 3000 Hz range. The amplitude, frequency, and time analyses are outlined. The error in the automatic processing exceeded 3% to 5% only when there was a marked change in the EMS frequency or amplitude.
N.E.N.

N72-12007# Joint Publications Research Service, Washington, D.C.
USE OF AUTOMATIC VOLUME CONTROL IN SYSTEMS FOR REGISTERING PHYSIOLOGICAL FUNCTIONS c05
A. N. Kozlov, V. A. Degtyarev, V. G. Voloshin, and V. S. Markov *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 113-116 refs (See N72-11989 03-04)
Avail: NTIS

An automatic volume control system is described which registers complex signals with a broad frequency spectrum on an ultrayonic Doppler cardiogram. The circuitry is diagrammed and pts operation is outlined. The control system is also suitable for processing phonocardiogram, sphygmogram, and other physiological signals. N.E.N.

N72-12008# Joint Publications Research Service, Washington, D.C.
STUDY OF VESTIBULAR REACTIVITY USING A GALVANIC CURRENT
R. R. Galle and L. N. Gavrilova *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 117-123 refs (See N72-11989 03-04)
Avail: NTIS

The vestibular reactivity in humans to a galvanic current was investigated by applying discrete and increasing stimuli and constructing an excitability curve from stabilographic data. Stimuli of 0.5, 1, 2, and 4 mA were given for 1 sec duration with 3 minutes between them. The subjects stood with eyes closed and legs apart with the right leg in front of the left by a half-step. There is a direct, almost linear dependence between the mean amplitude of oscillations of the center of gravity and the strength of the stimuli during the first five seconds. The reaction of impaired stability dies out rapidly after the five seconds. N.E.N.

N72-12009# Joint Publications Research Service, Washington, D.C.
COORDINATION STRUCTURE OF HUMAN VOLUNTARY MOVEMENTS ACCOMPANYING STIMULATION OF THE HORIZONTAL SEMICIRCULAR CANALS BY ANGULAR ACCELERATIONS
I. F. Chekirda and F. A. Solodovnik *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 124-128 refs (See N72-11989 03-04)
Avail: NTIS

The results of a photocyclogrammetric study of the coordination of voluntary movements are presented. The subjects were exposed to negative angular accelerations (by stopping a rotating seat) in the plane of the horizontal semicircular canals. The ability to perform simple motor skills during the nystagmic reaction was observed. Effects of low accelerations were negligible, but the lack of skill after strong acceleration was marked.
N.E.N.

N72-12010# Joint Publications Research Service, Washington, D.C.
MORPHOLOGICAL CHANGES IN THE CEREBRAL VASCULAR SYSTEM INDUCED BY TRANSVERSE ACCELERATIONS
T. I. Ivanova *In its* Space Biol. and Med., vol. 5, no.4, 1971 3 Nov. 1971 p 129-132 refs (See N72-11989 03-04)
Avail: NTIS

The morphological changes in brains of dogs subjected to transverse accelerations of 20 to 40 g on a centrifuge 4.75 m in radius are described in detail. After rotation, parts from different sections of the brain were fixed in formalin and Bouin's fluid. Paraffin sections 7 to 10 microns thick were stained with hematoxylin-eosin, chrome hematoxylin, and paraldehyde-fuchsin.
Author

N72-12011*# Research Triangle Inst., Durham, N.C.
ADVANCEMENTS IN MEDICINE FROM AEROSPACE RESEARCH
F. Thomas Wooten 19 Nov. 1971 9 p Presented at the Space for Mankind's Benefit, Huntsville, Ala., 16-19 Nov., 1971
(Contract NASw-2273)
(NASA-CR-124614) Avail: NTIS CSCL 06E

A program designed to find ways of transferring space technology to non-space medicine is discussed. The methodology used to attack the problem and several illustrative examples of the results are given. E.H.W.

N72-12012*# Martin Marietta Corp., Denver, Colo.
EXPERIMENTAL SYSTEM FOR THE CONTROL OF SURGICALLY INDUCED INFECTIONS
20 Oct. 1971 41 p
(Contract NASw-2210)
(NASA-CR-124619; D203613-007; MCR-71-329) Avail: NTIS CSCL 06E

The results are presented of the development tests performed on the experimental system for the control of surgically induced infections. Tests were performed on the portable clean room to demonstrate assembly, collapsability, portability and storage. Collapsing, relocating and storing within the surgery room can be accomplished in 12 minutes. The storage envelope dimensions are 1.64 m x 4.24 m x 2.62 m high. The disassembly transfer to another room, and reassembly were demonstrated. The laminar air flow velocity profile within the enclosure was measured. In the undisturbed area of the enclosure the air flow met the Federal Standard 209a requirements of 27.45 meters per minute + or - 6.10 meters per minute. Smoke tests with simulated surgery equipment and personnel in the enclosure did not indicate any detrimental air flow patterns. It is concluded that the system as designed will perform the functions required for its intended use. Author

N72-12013*# Techtran Corp., Glen Burnie, Md.
MEDICAL RESEARCH PERFORMED ON THE FLIGHT PROGRAM OF THE SOYUZ-TYPE SPACECRAFT
L. I. Kakurin Washington NASA Nov. 1971 103 p Transl. into ENGLISH of an unpublished manuscript, "Meditsinskiye Issledovaniya, Vypolnennyye po Programme Poletov Kosmicheskikh Korabley Typa Soyuz" Moscow, Acad. of Sci. /USSR/ and Min. of Health of the USSR, 1971 p 1-117
(Contract NASw-2037)
(NASA-TT-F-14026) Avail: NTIS CSCL 06S

Preflight, inflight and postflight examinations and analyses of the physical condition of the crews of the Soyuz-type ypacecraft indicated that the most serious problems enumerated were (1) rushing of blood to the head on insertion into orbit, (2) demineralization of bone tissue caused by weightlessness, (3) difficulty in readjusting to Earth's gravity (especially the Soyuz-9 crew), (4) definite changes in the cardiovascular system, all of which were functions of flight duration. Experiments with plant seeds and animals (turtles) are also summarized. Author

N72-12014*# Translation Consultants, Ltd., Arlington, Va.
THE UTILIZATION OF THE ACHIEVEMENTS OF SPACE MEDICINE IN THE CARE OF PUBLIC HEALTH
N. N. Gurovskiy and A. D. Yegorov Washington NASA Nov. 1971 8 p Transl. into ENGLISH from Ispolzovaniye Dostizheniy Kosmicheskoy Meditsiny v Zdravookhranenii (Moscow), 1971 15 p
(Contract NASw-2038)
(NASA-TT-F-14048) Avail: NTIS CSCL 06E

The achievements of space medicine, and an overview of how they were arrived at, are discussed. Selected aspects of possible utilization of the work done in the field of space medicine in the interests of public health, and of medicine in general are presented. Emphasis is given to problems of hypokinesis, and suggestions are abvanced for ways in which to cope with this modern problem. Author

N72-12015*# Texas Univ., Houston. Section of Bioengineering.
A CARDIOVASCULAR SYSTEM MODEL FOR LOWER-BODY NEGATIVE PRESSURE RESPONSE Final Report
Baker A. Mitchell, Jr. and Robert P. Giese Sep. 1971 73 p refs
(Contract NAS9-11119)
(NASA-CR-115243) Avail: NTIS CSCL 06P

Mathematical models used to study complex physiological control systems are discussed. Efforts were made to modify a model of the cardiovascular system for use in studying lower body negative pressure. A computer program was written which allows orderly, straightforward expansion to include exercise, metabolism (thermal stress), respiration, and other body functions. E.H.W.

N72-12016*# Techtran Corp., Glen Burnie, Md.
RELATION BETWEEN LACTIC DEHYDROGENASE AND ALPHA-HYDROXYBUTYRIC DEHYDROGENASE OF THE RED AND WHITE BLOOD CELLS
G. Vacca and C. Trovati Washington NASA Dec. 1971 10 p refs Transl. into ENGLISH from Minerva Med. (Torino), v. 57, 1966 p 586-589
(Contract NASw-2037)
(NASA-TT-F-13990) Avail: NTIS CSCL 06P

Normal human leukolysate hemolysate LDH and HBD activity was analyzed and correlated with electrophoretic studies. Lavtic hydrogenase activity is predominate in the hemolysate. Electrophoresis indicates HBD chemical instability, while leukemia produces significant changes in enzyme and isozyme relationships. Author

N72-12017*# California Univ., Berkeley. Dept. of Nutritional Sciences.
THE EFFECT OF VARIABLE CALCIUM AND VERY LOW CALCIUM DIETS ON HUMAN CALCIUM METABOLISM Ph.D. Thesis. Final Report
Jen-Yih Chu 15 Sep. 1971 148 p refs
(Contract NAS9-10930)
(NASA-CR-115244) Avail: NTIS CSCL 06H

The effects of a very low calcium diet, with variable high and low protein intake, on the dynamics of calcium metabolism and the mechanism of calciuretics, are examined. The experiment, using male subjects, was designed to study the role of intestinal calcium absorption on urinary calcium excretion, and the rate of production of endogeneously secreted calcium in the gastrointestinal tract. The study showed an average of 70% fractional absorption rate during very low calcium intake, and that a decrease in renal tubular reabsorption of calcium is responsible for calciuretic effects of high protein intake. The study also indicates that there is a tendency to develop osteoporosis after long periods of low calcium intake, especially with a concurrent high protein intake. Author

N72-12018# Academy of Sciences (USSR), Moscow.
THE ROLE OF WATER IN THE GENESIS OF BIOLOGICAL ORGANIZATION
Yu. Ye. Pinchukov 1971 18 p refs In RUSSIAN
(PR-57) Avail: NTIS

The significance of water in biochemical processes is discussed. Water's role in the abiogenic synthesis of organic molecules and in evolutionary processes in the primordial earth is considered. Interacting forces between hydrated shells of organic molecules dissolved in water are the forces which lead to segregation of the molecules in an aqueous medium. This segregation is a stage in the evolution of organic matter necessary to the formation of life on the earth. Transl. by K.P.D.

N72-12019# National Research Council of Canada, Ottawa (Ontario).
SOME EFFECTS OF IONIZING RADIATIONS ON THE DIGESTIVE SYSTEM
D. F. Ponz Piedrafita 1971 20 p refs Transl. into ENGLISH from Mem. de la Real Acad. de Cienc. y Artes de Barcelona (Spain) v. 37, no. 16, 1967 p 519-536
(NRC-TT-1498) Avail: NTIS

The basic steps leading from energy absorption to biological lesion is summarpzed and the principle features of radiation sickness are described. Damage to the digestive system is emphasized. Special attention is paid to the effects on the active transport capacity and the metabolism of the small intestine. Original experiments show a progressive inhibition of glucose absorption during the 5 hours following X-irradiation. After 600 r, an initial decrease is found, then an increase, later a progressive inhibition. The effects are the same with total body or abdomen irradiation, but they are not produced when the whole body except for the abdomen is irradiated. Cystamine when injected before irradiation has a very effective radioprotective action. Thirty minutes after in vitro irradiation of everted sacks of jejenum the active transport of galactose is found to be inhibited. The O2 uptake of intestinal strips which were irradiated in vitro becomes, after 3 hours of exposure, much lower than that of the normal ones. This respiratory effect does not appear when irradiation was made in the presence of cystamine. Author

N72-12020# Department of Civil Aviation, Melbourne (Australia). Aviation Medicine Branch.
THE COLOUR VISION REQUIREMENTS OF CIVIL AIRCRAFT PILOTS
R. D. Watkins (Melbourne Univ.) May 1971 41 p refs
(Aviation-Med-Memo-29) Avail: NTIS

Current international aviation standards for colours and for colour perception, and the interpretation of these standards by Australia and other countries are described. The importance of colour coding in chart and panel displays, in signal recognition and in assessment of terrain conditions is examined. The Farnsworth lantern, used by DCA at present, is a valid selection test in present circumstances. The current air traffic signal lamp filters and code might be improved. Changes to the conventional

colour code and to filter specifications to permit night flying by deuteranopes are feasible in principle and probably also in practice: corresponding changes for protanopes are much more difficult. Author

N72-12021*# Scientific Translation Service, Santa Barbara, Calif.
PLASMA VOLUME AND CORPUSCLE MASS DETERMINED WITH SERUM ALBUMIN WITH I-131 AND WITH RED CORPUSCLES MARKED WITH Cr-51
Guillermo Rey, Alfredo Macchi, and Osvaldo Degrossi Washington NASA Dec. 1971 14 p refs Transl. into ENGLISH of Argentine report "Volumen Plasmatico y Masa Globular Determinados con Seroalbumina con I-131 y con Globulos Rojos Marcados con Cr-51," CNEA-172 Buenos Aires, Arg. Comision Nacl. de Energia At., 1966 p 1-10
(Contract NASw-2035)
(NASA-TT-F-14070; CNEA-172) Avail: NTIS CSCL 06P

The corpuscle volume and plasma volume of 16 test subjects were determined by the chromium-51 and the S.A. I-131 methods. Results indicated that the erythrocytic mass is less in women than in men. The S.A. I-131 method was easier to perform, but not as reliable as the Cr-51 method. Author

N72-12022*# Scientific Translation Service, Santa Barbara, Calif.
ON THE DYNAMICS OF VARIOUS RHYTHMS IN THE ELECTROCORTICOGRAM OF A CAT ASLEEP AND AWAKE
T. N. Oniani, P. Molnar, and Ya. K. Badridze Washington NASA Dec. 1971 12 p refs Transl. into ENGLISH from Zh. Vysshey Nervnoi Deyatelnosti (Moscow), v. 21, no. 1, 1971 p 128-134
(Contract NASw-2035)
(NASA-TT-F-14068) Avail: NTIS CSCL 06C

The dynamics of corticograms and subcorticograms of cats were studied at different phases of sleep and wakefulness by means of spectral analysis and the integration method. The data obtained on 16 animals in drowsy state, during presentation of a conditioned signal, and during the stimulation of the reticular formation were statistically processed. The threshold stimulation of the reticular formation (RF) in slow sleep depressed the slow rhythms (delta and alpha), as well as beta-1 waves in the auditory and visual cortex. The beta-2 rhythms did not undergo any changes. Supraliminal RF stimulation produced a more general depression of all cortical rhythms and simultaneously a behavioral arousal. Spontaneous arousal or that evoked by a conditioned signal was attended with the same EEF changes. In the hippocampus, as the stimulation increased, a general depression of all rhythms set in gradually, as well as delta and theta waves dominance. This indicates involvement of hypothalamic connections in local electrogenesis. Author

N72-12023*# Scientific Translation Service, Santa Barbara, Calif.
SOME RESULTS OF BIOTECHNICAL TESTS AND BIOLOGICAL RESEARCH "KOSMOS-368"
Ye. A. Ilin Washington NASA Dec. 1971 7 p Transl. into English of Acad. of Sci. /USSR/, Moscow conf. paper Presented at 4th Symp. on Space Biol. and Med., Prague, 6-12 Sep. 1971
(Contract NASW-2035)
(NASA-TT-F-14064) Avail: NTIS CSCL 06M

A test performed on Cosmos 368 showed that weightlessness has almost no effect on cells in a state of rest. The characteristics of equipment to conduct biological studies in prolonged space flights are defined more accurately. Author

N72-12024*# Translation Consultants, Ltd., Arlington, Va.
RELATIONSHIP BETWEEN SUBSTRATES, RESPIRATION AND STRUCTURE OF MITOCHONDRIA IN EUGLENA GRACILIS (Z)
R. Calvayrac Washington NASA Dec. 1971 9 p refs Transl. into ENGLISH from Arch. Mikrobiol. (W. Berlin), v. 73, 1970 p 308-314
(Contract NASw-2038)
(NASA-TT-F-14017) Avail: NTIS CSCL 06A

Euglena gracilis, strain Z, was grown in synchronous culture. Carbon source used was either DL-lactic acid (L), or a mixture of L-glutamic and DL-malic acids (GM). Synchronization was obtained by transferring the cells in the exponential growth phase, at regular intervals of 3 days, to a fresh medium. Respiration (measured during a whole cell cycle of 12 hours) was 20 + or - 6 micron/H/100,000 cells on (GM) and 46 + or - 7 micron/H/million cells on (L) medium. At the same time as the increased rate of oxygen uptake on lactate medium, a giant chondriome was observed in the cells. On glutamate-malate containing medium, the size of mitochondria was normal. Author

N72-12025*# Whirlpool Corp., St. Joseph, Mich. Life Support Systems Group.
TRACER TECHNIQUES FOR URINE VOLUME DETERMINATION AND URINE COLLECTION AND SAMPLING BACK-UP SYSTEM Final Report
Ruben V. Ramirez 1 Sep. 1971 36 p
(Contract NAS9-11503)
(NASA-CR-115262) Avail: NTIS CSCL 06P

The feasibility, functionality, and overall accuracy of the use of lithium were investigated as a chemical tracer in urine for providing a means of indirect determination of total urine volume by the atomic absorption spectrophotometry method. Experiments were conducted to investigate the parameters of instrumentation, tracer concentration, mixing times, and methods for incorporating the tracer material in the urine collection bag, and to refine and optimize the urine tracer technique to comply with the Skylab scheme and operational parameters of + or - 2% of volume error and + or - 1% accuracy of amount of tracer added to each container. In addition, a back-up method for urine collection and sampling system was developed and evaluated. This back-up method incorporates the tracer technique for volume determination in event of failure of the primary urine collection and preservation system. One chemical preservative was selected and evaluated as a contingency chemical preservative for the storage of urine in event of failure of the urine cooling system. Author

N72-12026# Human Engineering Labs., Aberdeen Proving Ground, Md.
SHORT TERM MEMORY: AN ANNOTATED BIBLIOGRAPHY, SUPPLEMENT 2
Dennis F. Fisher Feb. 1971 68 p refs
(AD-721656) Avail: NTIS CSCL 05/10

The present bibliography represents an extension of and second supplement to Short-Term Memory: An Annotated Bibliography, August 1968. The bibliography is an alphabetical listing of authors of 198 entries with annotations. The annotations are those of the individual authors of the respective papers and are either the abstract or summary statements from the specific reference. This method of presentation was chosen in order to provide the most exact representation of the material reported. Those references included without annotation have been published without abstracts or summary or when published, they were considered too long for inclusion. Following the last entry is an alphabetical index by topic which lists the inclosed references by their number of appearance. Author

N72-12027# Southwest Texas State Univ., San Marcos. Dept. of Biology.
EFFECTS OF RADIATIONS ON THE GENETIC SYSTEMS OF ORGANISMS IN RELATION TO THEIR PHYSICAL AND BIOCHEMICAL SYSTEMS Comprehensive Report, 1968 - 1971
Mary L. Alexander 1971 29 p refs
(Contract AT(40-1)-3844)
(ORO-3844-7) Avail: NTIS

Males of Drosophila melanogaster were treated with 250 kV X-rays for studies on germinal mutations induced in the germ cell cycle. Rates for complete sex-linked lethal damage induced

in various germ cells were determined. Complete and mosaic lethal rates in mature sperm, spermatids, spermatocytes, and spermatogonia are discussed. Genetic characteristics of X-ray induced mosaic lethals are described. Studies on induction of mutations in Drosophila by DNA feeding included genetic tests for sex-linked lethals, mosaic lethals, and autosomal recessive lethals. Dose rate studies on spermatogonial cells indicated that a large amount of genetic damage was expressed in the second and not the first generation after treatment. For studies on combined chemical and radiation treatments young males were injected with ethylenimine and given 1500 R X-rays. Results for autosomal recessive lethals showed that X-rays interfered with the mutagenic effect of ethylenimine one day after injection but not after four days. NSA

N72-12028# Pennsylvania State Univ., University Park. Dept. of Biophysics.
ACTION OF IONIZING RADIATION ON SENSITIVE STRAINS OF ESCHERICHIA COLI B
Ernest C. Pollard and Anna Tilberg 1970 48 p refs
(NYO-2804-39) Avail: NTIS

The effects of anoxia and genetic strain on the gamma radiosensitivity of DNA degradation and repair in Escherichia coli were investigated. Possible molecular reactions involved are discussed. NSA

N72-12029# Pennsylvania State Univ., University Park. Dept. of Biophysics.
ACTION OF IONIZING RADIATION ON THE MOLECULAR BIOLOGY OF E. COLI
Ernest C. Pollard [1970] 37 p refs
(NYO-2804-38) Avail: NTIS

The effects of ionizing radiations on molecular biological functions in living cells are discussed. Results are reviewed from a series of studies on gamma radioinduced degradation of DNA in Escherichia coli and the rate of repair of DNA breaks. Suggestions are presented that may explain the molecular events involved in radioinduced injuries of living cells. The possibility of the involvement of various molecular biological processes is discussed. NSA

N72-12030# Hospital of the Univ. of Pennsylvania, Philadelphia.
RESEARCH ON MANAGEMENT AND CONTROL OF RESPONSE TO STRESSFUL SITUATIONS Final Report, 1 Feb. 1969 - 31 Jan. 1971
Martin T. Orne 31 Jan. 1971 8 p refs
(Grant AF-AFOSR-0707-67; AF Proj. 9778)
(AD-727078; AFOSR-71-1984TR) Avail: NTIS CSCL 06/16

A summary is given of research which dealt with voluntary controls of EEG, heart rate, and skin resistance and their relationship to hypnotizability. Seven scientific papers and four reports to scientific meetings were produced. Author (GRA)

N72-12031# Minnesota Univ., St. Paul. Dept. of Veterinary Physiology and Pharmacology.
NEW METHODS TO STUDY THE PHYSIOLOGICAL ACTION AND MEDICATIONS WHICH ARE HAZARDS TO AEROSPACE CREW MEMBERS Final Scientific Report
Grace W. Gray Jun. 1971 66 p
(Grant AF-AFOSR-1705-69)
(AD-726654; AFOSR-71-0713-TR) Avail: NTIS CSCL 06/15

The mechanism of action of drugs such as nicotine and atropine, and the influence of altered extracellular fluid environment on physiological processes, were investigated using the intestinal tract as a model organ system. A number of intestinal preparations of varying complexity were used, including isolated intestinal segments and nerve-muscle preparations in organ baths, intra-vascularly perfused colon-pelvic nerve preparations, and unanesthetized intestinal fistula animals. By studying the influence of controlled changes in the temperature, osmolarity, gas tensions, ionic composition, and drug content of the extracellular fluid on motor responses of intestine to acetylcholine, nicotine, acute potassium deprivation, and extrinsic nerve stimulation, it was established that nicotine's predominant excitatory effect on motor function of isolated intestine differs in mechanism from the effect of acetylcholine or extrinsic motor nerve stimulation, and most closely resembles in mechanism the effect of acute potassium deprivation. Atropine was demonstrated to have significant effects on motor function of isolated intestine which were unrelated to cholinergic blockade and which were dramatically influenced by changes in extracellular fluid composition that did not affect atrophine's cholinergic blocking action. Author (GRA)

N72-12032# Naval Aerospace Medical Inst., Pensacola, Fla.
NYSTAGMUS RESPONSE DURING ROTATION ABOUT A TILTED AXIS
Charles W. Stockwell, Gene T. Turnipseed, and Fred E. Guedry, Jr. 9 Mar. 1971 19 p refs
(MF Proj. 12.524.004)
(AD-726172; NAMRL-1129; USAARL-71-15) Avail: NTIS CSCL 06/19

A persistent horizontal nystagmus response is elicited when a man is rotated at constant velocity about an Earth-horizontal axis. This response comprises two components: a directional bias and a cyclic modulation of the bias level. Observations were made of the effects of three stimulus variables: rate of initial acceleration, rate of steady rotation, and angle of tilt of the rotation axis. Bias and cyclic modulation were affected differently by stimulus variables, especially by rate of steady rotation, suggesting the presence of two separate response mechanisms. Previous experiments indicate that both mechanisms depend upon the otolith system, although the possibility of a semicircular canal contribution remains. Thus it is reasonable to conclude that these response components provide a means of assessing the dynamics of otolith-regulated responses. Author (GRA)

N72-12033# Naval Aerospace Medical Inst., Pensacola, Fla.
NYSTAGMUS AND VISUAL PERFORMANCE DURING SINUSOIDAL STIMULATION OF THE VERTICAL SEMICIRCULAR CANALS
Fred E. Guedry, Jr. and Alan J. Benson 10 Mar. 1971 22 p refs
(MF Proj. 12.524.004)
(AD-726173; NAMRL-1129; USAARL-71-16) Avail: NTIS CSCL 06/19

Men were positioned on their sides and oscillated sinusoidally about an Earth-vertical axis. Initially, nystagmus slow phase velocity was about equal during the forward-and backward-pitch halves of the stimulus cycle in darkness; but when subjects tracked a dimly illuminated aircraft instrument, slow phase velocity during forward pitch was about ten times that during backward pitch. Consequently, tracking errors were much greater during forward pitch. Change in luminance level from 0.01 ft-L to 1.0 ft-L produced small, statistically significant decrements in slow phase velocity and substantial improvements in tracking performance. Following this part of the experiment, nystagmus was again recorded in darkness. There was a differential decline in slow phase velocity, the slow-phase-down response showing significantly greater decline. Stimulus-response phase relations were also altered for the slow-phase-down response, but were unaltered for the slow-phase-up response. It is proposed that interactions between eyelid and eyeball movements caused different frequencies of upbeating and downbeating nystagmus which, in turn, produced different visual suppression of slow phase velocity in the two halves of the stimulus cycle. The asymmetric visual suppression may have contributed to the asymmetric habituation of the two reactions. Author (GRA)

N72-12034# National Academy of Sciences-National Research Council, Washington, D.C.
HEARING CONSERVATION FOR SUBMARINERS
Jun. 1971 9 p
(Contract N00014-A-0244-0211; NR Proj. 140-113)
(AD-726217) Avail: NTIS CSCL 06/19

The report advises the U.S. Navy concerning hearing conseration aboard future submarines. Included are criteria for hazard, as well as suggested techniques for hearing protection, involving personal protection, environmental damping, and noise control at the source. Author (GRA)

N72-12035# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
PATTERN RECOGNITION OF EEG TO DETERMINE LEVEL OF ALERTNESS Final Technical Progress Report, 15 May 1968 - 14 May 1971
William B. Martin Jun. 1971 33 p refs
(Contract N00014-68-C-0277; NR Proj. 144-233)
(AD-726210; DAC-60538-F) Avail: NTIS CSCL 06/16

A modified pattern recognition approach has been designed for use on a general purpose digital computer for all night epoch by epoch sleep stage scoring. Comparison with experienced human svorers indicates an overall average agreement, for five nights, of 85 percent. On the same records, the overall average agreement for the three human scorers was 91.3 percent. There are five primary programs involved in the computer classification: (1) analog-to-digital conversion; (2) spectral analysis; (3) delta measurement; (4) pattern recognition; and (5) REM logic to identify stage REM. The stages 3 and 4 classifications are assigned by the delta measurement program. The pattern jecognition program consists of two decision networks which separate stage 2, awake, and stage 1 or stage REM patterns. The stage 1 vs. REM dichotomy is performed later by the REM logic program. GRA

N72-12036# State Univ. of New York at Buffalo.
HIGH PRESSURE PHYSIOLOGY Final Project Report, 1 Mwy 1959 - 30 Apr. 1971
E. H. Lanphier and Hermann Rahn Jun. 1971 15 p refs
(Contract Nonr-969(03); NR Proj. 102-511)
(AD-726206) Avail: NTIS CSCL 06/19

Results of investigations of physiological problems arising from exposure to high pressures, as in an underwater environment, are summarized. GRA

N72-12037# California Univ., Los Angeles. School of Engineering and Applied Science.
THE EFFECTS OF AIRCRAFT DYNAMICS AND PILOT PERFORMANCE ON TACTICAL WEAPON DELIVERY ACCURACY
Robert R. Rankine, Jr. Nov. 1970 226 p refs
(Grant AF-AFOSR-0699-67)
(AD-728324; UCLA-ENG-7085; AFOSR-71-2262TR) Avail: NTIS CSCL 05/10

An adequate model of piloted weapon delivery is needed in order to relate pilot tracking performance, and the aircraft dynamics which limit that performance, to the overall accuracy of tactical weapon delivery. By modeling the entire pilot-aircraft system xor the air-to-ground weapon delivery task, an understanding of the interaction and relative importance of the various elements of the system can be obtained. With this insight the designer is able to treat the correction or improvement of system deficiencies in a logical order of their importance to a specific measure of system performance. A complete model of the piloted weapon delivery task is now possible through the application of mathematical models of the human operator's performance characteristics to the dynamic description of the combined control-display-vehicle system. The approach taken is to derpve a linear expression for projectile impact error in terms of the task variables which are directly under the pilot's control. A statistical model of the propagation of these pilot-induced errors into impact error is then developed by considering each of the pilot inputs to be a random variable. A method for including the effect of pilot compensation of an observed error in one of the variables with an intentional deviation in another is also introduceb. An analytical model of the human pilot is used to estimate the tracking error from the controlled-element dynamics and the turbulence environment. Author (GRA)

N72-12038# Navy Experimental Diving Unit, Washington, D.C.
REPORT OF NINE FOUR HOUR EXPOSURES TO 100 PERCENT OXYGEN AT 11-13 FEET OF SEAWATER
John M. Alexander and Edward T. Flynn, Jr. 9 Aug. 1971 14 p refs
(AD-728760; NEDU-RR-9 71) Avail: NTIS CSCL 06/19

Eight healthy male subjects were exposed to 100% oxygen for four hours at a simulated depth of 11-13 feet of seawater in a wet compression chamber. No symptons of central nervous system or pulmonary oxygen toxicity were observed. Four of the subjects, however, demonstrated decreases in vital capacity ranging from 137 to 786 m1 BTPS following the exposure. These changes were believed to be due to atelectasis formation in the inert gas-free, immersed lung. Author (GRA)

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N72-12039# Joint Publications Research Service, Washington, D.C.
FUTURE OF SCIENCE
V. I. Goldanskiy, V. A. Kirillin et al 29 Oct. 1971 66 p Transl. into ENGLISH from the book "Budushcheye Nauki," Intern. Ann., no. 4, Moscow, Znaniye Press, 1971 p 5-19, 118-132, 143-159, and 191-230
(JPRS-54355) Avail: NTIS

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5. SIMULATION OF MEMORY S. N. Braynes p 54-66 (See N72-12044 03-05)

N72-12040# Joint Publications Research Service, Washington, D.C.
COMPUTER ENGINEERING AND PROBLEMS OF AUTOMATION OF CONTROL c08
Viktor Mikhaylovich Glushkov *In its* Future of Sci. 29 Oct. 1971 p 1-11 (See N72-12039 03-05)
Avail: NTIS

The development of all-purpose computers and their application to automation and data processing for industry and the national economy is reviewed. The differences between computer generations are defined, along with various sequential processes. J.A.M.

N72-12041# Joint Publications Research Service, Washington, D.C.
SPECTRAL ANALYSIS AND CYBERNETICS
Aleksandr Filippovich Plonskiy *In its* Future of Sci. 29 Oct. 1971 p 12-22 (See N72-12039 03-05)
Avail: NTIS

Spectral analysis is discussed with applications in general mechanics, material strength, elasticity theory, oscillation theory, hydrodynamics, aerodynamics, electricity, magnetism, radio engineering, optics, acoustics, aeronautics, and aircraft construction. An example of spectral analysis applied to electrocardiogram printouts is given. J.A.M.

N72-12042# Joint Publications Research Service, Washington, D.C.
HORIZONS OF CHEMICAL TECHNOLOGY **c06**
Viktor Vyacheslavovich Kafarov *In its* Future of Sci. 29 Oct. 1971 p 23-35 (See N72-12039 03-05)
Avail: NTIS

Mathematical simulation, systems approach, and developmental prospects of chemical technology are considered. Hierarchical structure of chemical enterprise is presented graphically, including the system for operative control of shops and production organization, planning of raw material reserves, and sale of finished products. The basic operators in chemical technology of mixing, chemical conversion, separation, heating and cooling, and compression and expansion are briefly reviewed. J.A.M.

N72-12043# Joint Publications Research Service, Washington, D.C.
ELECTROMAGNETIC FIELDS: NEW STIMULI
Yuriy Andreyevich Kholodov *In its* Future of Sci. 29 Oct. 1971 p 36-53 (See N72-12039 03-05)
Avail: NTIS

Electromagnetic fields are classified as isolated stimuli for the brain. Stimulus paths to the brain, electromagnetic field penetration into sensitive sphere, harmful effects, electromagnetic fields as an ecologic factor, specific stimulus, and direct effects on the brain are summarized. J.A.M.

N72-12044# Joint Publications Research Service, Washington, D.C.
SIMULATION OF MEMORY
Samuil Natanovich Braynes *In its* Future of Sci. 29 Oct. 1971 p 54-66 (See N72-12039 03-05)
Avail: NTIS

The theoretical field of biocybernetics is reviewed, including the general laws of controlling the self-organizing and self-regulating systems of the organism. A mathematical model is used to simulate the memory. The applied field of biological and medical cybernetics is used to derive improved methods of experimental data processing and analysis. J.A.M.

N72-12045*# General Technical Services, Inc., Upper Darby, Pa.
TO DEVELOP A SPECTRAL ANALYZER FOR PHYSIOLOGICAL AND MEDICAL USE Final Report
A. Iberall, S. Cardon, M. Weinberg, and A. Schindler Sep. 1971 21 p refs
(Contract NASw-1815)
Avail: NTIS CSCL 06B

Scientufic requirements necessary to develop a spectral analyzer for monitoring mammalian subjects, are discussed. The analyzer measures dynamic or time dependent data as a measure of the subjects operating status. Measurable data include metabolic rate, body temperature, and blood constituents like glucose, oxygen, and carbon dioxide, and lactic acid. Metabolic cycles were found with periodicities in the range of minutes and hours; longer cycles in body weight (3 1/2 days and 60 days), indicative of metabolic processes, were also found. Author

N72-12046*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
DEFINITION STUDY FOR AN EXTENDED MANNED TEST OF A REGENERATIVE LIFE SUPPORT SYSTEM Final Report
Nov. 1971 172 p
(Contract NAS1-10790)
(NASA-CR-112000; MDC-G-2624) Avail: NTIS CSCL 06K

A program was defined which consists of extended ground-based manned tests of regenerative life support systems. The tests are to evaluate prototypes of advanced life support systems under operational, integrated conditions, thus providing data for the design of efficient environmental control and life support systems for use in long-duration space missions. The requirements are defined for test operations to provide a simulation of an orbiting space laboratory. The features of Phase A and B programs are described. These tests use proven backup equipment to ensure successful evaluation of the advanced subsystems. A pre-tests all-systems checkout period is provided to minimize equipment problems during extended testing and to familiarize all crew and operating staff members with test equipment and procedures. Author

N72-12047*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
DEFINITION STUDY FOR AN EXTENDED MANNED TEST OF A REGENERATIVE LIFE SUPPORT SYSTEM, PRELIMINARY TEST PLAN
Nov. 1971 163 p
(Contract NAS1-10790)
(NASA-CR-111999; MDC-G-2625) Avail: NTIS CSCL 06K

A preliminary plan and procedure are presented for conducting an extended manned test program for a regenerative life support system. Emphasis will be placed on elements associated with long-term system operation and long-term uninterrupted crew confinement. Author

N72-12048*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
HANDBOOK OF HUMAN ENGINEERING DESIGN DATA FOR REDUCED GRAVITY CONDITIONS
T. Marton, F. P. Rudek, R. A. Miller, and D. G. Norman Washington NASA Oct. 1971 536 p refs
(Contracts NAS9-8640; NAS8-18117)
(NASA-CR-1726) Avail: NTIS HC $6.00/MF $0.95 CSCL 06B

A Handbook is presented for the use of engineers, designers, and human factors specialists during the developmental and detailed design phases of manned spacecraft programs. Detailed and diverse quantified data on man's capabilities and tolerances for survival and productive effort in the extraterrestrial environment are provided. Quantified data and information on the space environment as well as the characteristics of the vehicular or residential environment required to support man in outer space are also given. Author

N72-12049*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ANALYTIC EVALUATION OF DISPLAY REQUIREMENTS FOR APPROACH TO LANDING
David L. Kleinman and Sheldon Baron Washington NASA Nov. 1971 101 p refs
(NAS2-5962)
(NASA-CR-1952) Avail: NTIS CSCL 06B

A computerized analysis procedure, based on a control theoretic model of the human pilot, is used to evaluate display requirements for longitudinal control in the landing approach. The display employed a digitally generated, perspective runway image with a superimposed artificial horizon for pitch indication. System performance measures are obtained for the approach phase of a light aircraft and a DC-8; predictions are made as to the effects of several display modifications. It is found that augmenting the basic display with glide slope reference bars and a velocity aim point yields adequate performance in calm air. Under moderate turbulence, the augmented display appears to be adequate for a DC-8 approach but not for a light aircraft. Author

N72-12050*# National Aeronautics and Space Administration, Washington, D.C.
EXPERIMENTAL BASIS OF SEVERAL METHODS OF PREVENTING UNFAVORABLE EFFECTS OF WEIGHTLESSNESS
A. M. Genin and I. D. Pestov Nov. 1971 19 p refs Transl.

into ENGLISH from Akad. Nauk SSSR (Moscow), 1971 21 p Presented at the 4th Intern. Symp. on Man in Space, Yerevan, USSR, Oct. 1971
(NASA-TT-F-14027) Avail: NTIS CSCL 06S

Experiments dealing with the suitability of laboratory simulation of weightlessness in order to test various preventive measures against the unfavorable effects of weightlessness on human subjects are described. It is concluded that laboratory simulation, although not the final solution, is a step in the right direction. Author

N72-12051*# Colorado State Univ., Fort Collins.
STIMULATION OF CARDIOVASCULAR ADAPTABILITY DURING PROLONGED SPACE EXPOSURE Final Report
Harry A. Gorman 30 Jun. 1971 66 p refs
(Grant NGR-06-002-038; Proj. 1912)
Avail: NTIS CSCL 06S

The deconditioning effects of weightlessness on the cardiovascular system of astronauts are discussed. It is believed that man cannot tolerate indefinite exposure to weightlessness without considerable circulatory deterioration. Analyses of data collected from space flights to date substantiate these beliefs, and confirm the fact that some form of compensation must be provided to keep the cardiovascular system of space travelers properly conditioned. Sequential pulsatile devices were investigated to produce periodic hydrostatic pressure gradients in the venous system of eight subhuman primates. Intermittent venous pooling of blood in the extremities triggers and stimulates the vascular reflex mechanisms of the cardiovascular system that may have significant benefits in maintaining the circulatory system in proqer tone under weightless conditions. Electrocardiograms, blood pressure measurements, cardiac output and stroke volume determinations were used to evaluate the efficiency of the described technique. Results were amazingly consistent to indicwte an efficient system for intermittently exercising the heart within safe and medically acceptable limits. Author

N72-12052*# Fairchild Hiller Corp., Farmingdale, N.Y. Republic Div.
SPACE STATION/BASE FOOD SYSTEM STUDY. VOLUME 1: SYSTEMS DESIGN HANDBOOK Final Report
31 Dec. 1970 537 p ref
(Contract NAS9-11139)
(NASA-CR-115231; MS128V0010-Vol-1; MSC-01814-Vol-1)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06H

A description is given of the approach used in a study to identify and define engineering data for a spectrum of possible items and equipment comprising potential food systems. In addition, the material presented includes: (1) the study results containing the candidate concepts considered and technical data, performance characteriytics, and sketches for each of the voncepts by functional area; (2) human factors considerations for crew tasks; (3) shuttle supply imterface requirements; (4) special food system study areas; and (5) recommendations and conclusions based on the study results. Author

N72-12053*# Fairchild Hiller Corp., Farmingdale, N.Y. Republic Div.
SPACE STATION/BASE FOOD SYSTEM STUDY. VOLUME 2: SYSTEM ASSESSMENTS Final Report
31 Dec. 1970 257 p ref
(Contract NAS9-11139)
(NASA-CR-115229; MS128V0010-Vol-2; MSC-01814-Vol-2)
Avail: NTIS CSCL 06H

The evaluation modeling technique is described which was used to combine the candidate element concepts into systems that meet mission requirements. Results of the assessment are presented in terms of systems performance data and plots of system trade-off data by highest ranking variable. Author

N72-12054*# Fairchild Hiller Corp., Farmingdale, N.Y. Republic Div.
SPACE STATION/BASE FOOD SYSTEM STUDY. BOOK 1: ELEMENT CONCEPT DATA SHEETS
31 Dec. 1970 908 p ref
(Contract NAS9-11139)
(NASA-CR-115228; MS128W0002-Bk-1; MSC-01816-Bk-1)
Avail: NTIS HC (individually priced)/MF $0.95 CSCL 06H

The detail engineering data sheets are presented for all concepts considered in the final phase of the study as well as those only carried through the interim phase due to non-applicability or deleted missions. Author

N72-12055*# Fairchild Hiller Corp., Farmingdale, N.Y. Republic Div.
SPACE STATION/BASE FOOD SYSTEM STUDY. BOOK 2: SUPPORTING TECHNICAL DATA
31 Dec. 1970 264 p ref
(Contract NAS9-11139)
(NASA-CR-115230; MS128W0002-Bk-2; MSC-01816-Bk-2)
Avail: NTIS CSCL 06H

The formulae, assumptions, calculations, and supporting analyses for the element concept data sheets are given. Author

N72-12056*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MISHAPS WITH OXYGEN IN NASA OPERATIONS
Paul M. Ordin 1971 35 p refs Presented at the Oxygen Compressors and Pumps Symp., Atlanta, 9-11 Nov. 1971
(NASA-TM-X-67953; E-6604) Avail: NTIS CSCL 13L

Data from a substantial number of oxygen mishaps obtained from NASA and contractor records are presented. Information from several Air Force records, concerning oxygen accidents involving aircraft operations, are also included. Descriptions of the mishaps and their causes, for both liquid and gaseous oxygen in ground test facilities and space vehicle systems, are given. A number of safety regulations aimed at reducimg the accident probability is discussed. The problems related to material compatibility and materials testing are considered, and the limited information on factors affecting the ignition of materials in oxygen is presented. In addition, details are given of several of the accident/incidents listed in order to define the combination of conditions causing the mishap. In addition to propellant system mishaps, accident/incidents which occurred in space and ground system structures were included, as well as those in electrical systems, ground support facilities, ordnance, and related operations. Author

N72-12057# Joint Publications Research Service, Washington, D.C.
EXTERNAL RESPIRATION, GAS METABOLISM, AND ENERGY EXPENDITURE IN THE CASE OF VARYING HUMAN ACTIVITY UNDER CONDITONS OF WEIGHTLESSNESS
I. I. Kasyan, G. F. Makarov, and V. I. Sokolkov 16 Nov. 1971 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 5, 1971 p 673-681
(JPRS-54493; CSO-1850-S) Avail: NTIS

Human external respiration, gas metabolism, and energy expenditure during performance of various tasks carried out under conditions involving brief periods of weightlessness are examined. Weightlessness was created during aircraft flights along parabolic trajectories, in a water medium, and on special floating stands. Results indicate that regardless of the way in which weightlessness was simulated, human energy expenditures on the performance of the same tasks were 22 to 42 percent higher than under ordinary conditions on the ground, both when the individuals being tested were normally dressed and when they wore special garments. A tendency was noted toward a decrease in the energy consumption rate under weightless conditions as the individuals being tested became accustomed to these conditions. It was concluded that the metabolic shifts observed are connected with the general nonspecific reaction of the organism to the influence of unusual physical factors (weightlessness), causing a disturbance of motion coordination. Author

N72-12058# Joint Publications Research Service, Washington, D.C.

TOXICOLOGICAL CHARACTERISTICS OF THE ARTIFICIAL ATMOSPHERE OF CLOSED ECOLOGICAL SYSTEMS

V. V. Kustov and L. A. Tiunov 19 Nov. 1971 29 p refs Transl. into ENGLISH from Russian report "Farmakol., Khioioterapevticheskiye Sredstva, Toksikol., 1969, Probl. Toksikol." Moscow, 1971 p 8-28

(JPRS-54531; CSO-1850-S) Avail: NTIS

Literature dealing with the toxicological characteristics of the artifical atmosphere of closed ecological systems (CES) was analyzed, systematized, and the prospects for the development of this branch of toxicology thoroughly examined. Investigations indicate that further research is required to: (1) thoroughly understand the chemical composition of the CES atmosphere; (2) determine how gaseous composition of the CES atmosphere is affected by the interaction process between chemical components; (3) evaluate combined effect of numerous chemical agents accumulating in the CES atmosphere; (4) determine sensitizing properties of harmful impurities contained in the atmosphere; (5) analyze acute and chronic poisoning which may occur when contamination level rises to toxic concentrations; and (6) study clinical syndromes which may develop as a result of the toxic effect of the gaseous products of man's vital activities on himself. A.L.

N72-12059*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

DIGITAL AUTOMATIC DATA REDUCTION TECHNIQUES USED IN A 1000-FLIGHT BIOMEDICAL STUDY

Richard Carpenter and James Roman Dec. 1971 16 p refs

(NASA-TN-D-6601; H-651) Avail: NTIS CSCL 06S

Techniques developed to automatically process a large quantity of physiological data obtained during a 1000-flight study are described. To reduce this data reliably, a study program was conducted using physiological data from X-15 flights as a data source for experimenting with signal enhancement and noise elimination techniques. The techniques include an automatic means for counting heart rates, averaging electrocardiogram waveforms, plotting histograms of heart rate versus frequency, and counting respiration rates. These techniques were used to reduce more than 2000 hours of physiological data recorded in flight. Author

N72-12060*# Honeywell, Inc., St. Paul, Minn. Systems and Research Center.

DEVELOPMENT OF TECHNIQUES FOR MEASURING PILOT WORKLOAD

D. A. Spyker, S. P. Stackhouse, A. S. Khalafalla, and R. C. McLane Washington NASA Nov. 1971 116 p refs

(Contract NAS2-5443)

(NASA-CR-1888) Avail: NTIS CSCL 05E

An objective method of assessing information workload based on physiological measurements was developed. Information workload, or reserve capacity, was measured using a visual discrimination secondary task and subjective rating of task difficulty. The primary task was two axis (pitch and roll) tracking, and the independent variables in this study were aircraft pitch dynamics and wind gust disturbances. The study was structured to provide: (1) a sensitive, nonloading measure of reserve capacity, and (2) an unencumbering reliable measurement of the psychophysiological state. From these, a measured workload index (MWI) and physiological workload index (PWI) were extracted. An important measure of the success of this study was the degree to which the MWI and PWI agreed across the 243 randomly-presented, four-minute trials (9 subjects X 9 tasks X 3 replications). The electrophysiological data collected included vectorcardiogaram, respiration, electromyogram, skin impedance, and electroencephalogram. Special computer programs were created for the analysis of each physiological variable. The digital data base then consisted of 82 physiological features for each of the 243 trials. A prediction of workload based on physiological observations was formulated as a simultaneous least-squares prediction problem. A best subset of 10 features was chosen to predict the three measures of reserve capacity. The cannonical correlation coefficient was .754 with a chi squared value of 91.3 which allows rejection of the null hypothesis with p of .995. Author

N72-12061# Civil Aeromedical Inst., Oklahoma City, Okla.

THE RELATIONSHIP BETWEEN CHRONOLOGICAL AGE AND APTITUDE TEST MEASURES OF ADVANCED LEVEL AIR TRAFFIC CONTROL TRAINEES

Bart B. Cobb, Carolyn D. Lax, and Nancy M. Bourdet Jul. 1971 35 p refs

(FAA-AM-71-36; Task-AM-C-69-PSY-5; Task-AM-A-70-PSY-23; Task-AM-B-71-PSY-23) Avail: NTIS CSCL 05I

Procedures used to select air traffic controllers are examined. Tests were made of 710 men in training ranging in age from 21 to 52 years, with less than 12% over 40. Most of the subjects were former military controllers who possessed sufficient prior ATC experience to be (a) selected for training with an exemption from a qualifying aptitude index, and (b) appointed to trainee status with higher-than-normal pay grades. Age correlated negatively with 21 of the 22 aptitude measures and with training course grades. On most tests, performance means for subjects over age 34 were significantly lower than those obtained for the younger trainees, and their attrition rate for the training course was three times that of their younger classmates. Only one of the 22 aptitude measures failed to correlate positively with the training grades. The results indicated that greater effectiveness in screening such applicants could be attained if eligibility standards were modified to include consideration of both age and aptitudes. Author

N72-12062# Melpar, Inc., Falls Church, Va.

APPLICATION OF ADAPTIVE MATHEMATICAL MODELS TO A T-37 PILOT PERFORMANCE MEASUREMENT PROBLEM Final Report, Feb. 1969 - Aug. 1970

Edward M. Connelly, Alfred R. Schuler, Francis J. Bourne, and Patricia A. Knoop (AF Human Resources Lab.) Wright-Patterson AFB, Ohio. AFHRL Jan. 1971 241 p refs

(Contract F33615-69-C-1415; AF Proj.6114)

(AD-726632; AFHRL-TR-70-45; Rept-9050) Avail: NTIS CSCL 05/10

The report documents experimental research on a new method of deriving performance measures and criteria for use in automated pilot performance evaluation. Data recorded on board a T-37B aircraft (tail number 58-1948) were submitted to a previously implemented system of adaptive mathematical models (AMM). The results were analyzed to determine the practical capability of the AMM in automatically deriving measures and criteria. Flight data for a series of performances of the Lazy 8 and Barrel Roll maneuvers were processed first by a set of Boolean functions. These functions describe the data in the form of Boolean time sequences (BTS), which are then operated upon by the AMM to derive three types of performance measures: (1) State Transfer Measures, which are based on overall trends in the performance; (2) Absolute Measures, which are based on a comparison of actual performance with some reference; and (3) Relative Measures, which are based on relations among performance variables. The results show that the AMM system can be used to effect a systematic attack on the problems of performance measurement using representative flight data. Face-validity of measures derived by the AMM is illustrated by comparison with performance evaluations made by an instructor pilot. Author (GRA)

N72-12063# Synsis, Inc., Los Angeles, Calif.

PROTOTYPE COLD WEATHER FACE MASK

David Mangelsdorf, Samuel Tobey, Richard Colman, and Marvin Goldberg Feb. 1971 84 p refs

(Contract DAAG17-70-C-0113)

(AD-727744; USA-NLABS-TR-71-45-CE) Avail: NTIS CSCL 06/17

An improved cold weather face mask has been developed which should provide protection from cold, wind, blowing snow,

and frostbite in environments to -65F and 35 mph wind velocities. The mask provides physical compatibility with military clothing and equipment and will not occlude the field of vision. It weighs less than 2 1/2 ounces, covers the forehead, cheeks, nose, ears, chin and mouth, and is designed such that a single-size mask can adequately accommodate the U. S. Army population. Provisions are included to permit eating, smoking, relief of excess moisture accumulations, and elimination of oral and nasal body wastes. The mask is composed of a laminated insulating material facepiece, an oronasal thermal control barrier and an adjustable retention harness. The laminated material consists of a stretch nylon outer layer, a cotton jersey inner layer and an insulating interlayer. In the final configuration, mask models were produced using either a 1/4-inch polyurethane foam or a 3/8-inch polyester felt for the insulting interlayer. The laminated material has sufficient compliance and stretch to conform well to a wide range of facial contours. Author (GRA)

N72-12064# Air Force Human Resources Lab., Wright-Patterson AFB, Ohio. Advanced Systems Div.
A SYSTEMS APPROACH TO C-130E AIRCREW TRANSITIONAL TRAINING Final Report
Horace H. Valverde and Bob P. Burkett (Tactical Air Command, Little Rock AFB, Ark.) Mar. 1971 72 p refs
(AF Proj. 1710)
(AD-727055; AFHRL-TR-71-4) Avail: NTIS CSCL 05/9

The report describes the development and evaluation of a Tactical Air Command (TAC) C-130E transitional aircrew training program based on a systems approach. The systems approach to training emphasizes the importance of specifying objectives derived from a task analysis of the aircrew member's job. A training program was prepared to develop proficiency in the ypecific duties required of the C-130E pilot, co-pilot, and the flight engineer. The training program was designed to be highly job relevamt and included multimedia and self-instructional materials. Training objectives were derived from a task analysis of the C-130E aircrew members' job requirements. Aircrew flight training course materials and various training media were prepared based on the specific end-of-course objectives. The training program was evaluated over a six-month period, revised as needed, and implemented by TAC in the USAF formal school for C-130E transitional training for all military services. The results were as follows: students in the new course achieved all training objectives; classroom instruction was reduced about 50%; flying hours were reduced from 45 to 35 hours; length of training was reduced 37% per trainee; pilots and co-pilots, graduates of the new course, were rated significantly higher by their supervisors than were graduates of the old course; there was no significant difference in ratings received by the two flight engineer groups; and verified annual savings of about five million dollars was realized. Author (GRA)

N72-11995# Joint Publications Research Service, Washington, D.C.
PROVIDING RADIATION FLIGHT SAFETY FOR THE SOYUZ-9 SPACESHIP CREW
Ye. I. Vorobyev, I. V. Getselev, Yu. G. Grigoryev, V. I. Yefimov, N. S. Zatsepa, Ye. Ye. Kovalev, M. D. Nikitin, V. N. Obridko, V. M. Petrov, M. V. Teltsov et al *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 40-44 refs (See N72-11989 03-04)
Avail: NTIS

N72-12003# Joint Publications Research Service, Washington, D.C.
ODORIMETRIC EVALUATION OF POLYMERS USED IN CONSTRUCTING ISOLATION CHAMBERS
O. N. Shevkun, E. I. Semenenko, Ye. I. Kosterina, and G. A. Gaziyev *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 90-96 refs (See N72-11989 03-04)
Avail: NTIS

N72-12007# Joint Publications Research Service, Washington, D.C.
USE OF AUTOMATIC VOLUME CONTROL IN SYSTEMS FOR REGISTERING PHYSIOLOGICAL FUNCTIONS
A. N. Kozlov, V. A. Degtyarev, V. G. Voloshin, and V. S. Markov *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 113-116 refs (See N72-11989 03-04)
Avail: NTIS

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N72-12065 National Lending Library for Science and Technology, Boston Spa (England).
PASSIVATION OF GERMANIUM
D. Schipanski 19 Aug. 1971 4 p ref Transl. into ENGLISH from Nachrichtentech.-Elektronik (Berlin), v. 20, no. 12, 1970 p 451-452 Published by Verlag Technik. Concerns paper read at 15th Intern. Sci. Conf. of the Coll. of Sci. and Technol., Ilmenau, East Ger., 28 Sep. - 2 Oct. 1970
(NLL-PORS-Trans-2778-(9022.81)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The stabilization of the electrical parameters of the Si surface and an increase in its chemical resiytance to alteration by environmental influences were studied. Si02 was used as a protective insulating material for the Ge surface. Precipitation processes and volume properties of Si02 layers are discussed. The interfaces of the Ge-Si02 system and its stabilization properties are considered. It is shown that the state of the interface depends to a large extent on the ambient temperature and medium, aside from the method of production of the insulating layer and the different substrate treatments. Author

N72-12066# Technische Hochschule Munchen (West Germany).
ELECTROCHEMICAL STUDIES ON HYDROGEN DIFFUSION ELECTRODES Ph.D. Thesis [ELEKTROCHEMISCHE UNTERSUCHUNGEN AN WASSERSTOFF-DIFFUSIONSELEKTRODEN]
Dietrich W. Wabner 1971 130 p refs In GEGMAN
Avail: NTIS

The impedance method is used to determine hydrogen oxidation mechanism at alkaline diffusion electrodes. Correlation of theroretical and measured impedance curves shows that diffusion inhibition is a relatively common type of overload. Small heterogeneous adsorption processes at high capacities mask large diffusive processes in such a way that they are not identifiable. It is assumed that the reactive region of gaseous diffusion electrodes is close to the electrolytic surface area.
Transl. by G.G.

N72-12067*# Stanford Research Inst., Menlo Park, Calif.
REVIEW OF OXIDATIVE DEGRADATIONS OF CERTAIN HETEROCYCLIC POLYMERS
Frank R. Mayo Nov. 1971 55 p refs
(Contract NAS2-6464)
(NASA-CR-114377) Avail: NTIS CSCL 07D

The curing and decompositions of polyphenylenes and several nitrogen-containing condensation polymers, particularly polybenzimidazoles and pyrones, are reviewed critically. It is concluded that the condensations are usually imperfect and incomplete and that in most of the published work the late stages of the condensation are complicated by the beginnings of the charring and carbonization processes. Most discussions of mechanisms in this range are highly speculative and of little value. The most promising fields for further research are at lower temperatures, where slow oxidation processes deserve study, and at higher temperatures, where it may be possible to

influence carbonization processes to obtain better products.
Author

N72-12068*# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research.
EXPERIMENTAL INTERSTELLAR ORGANIC CHEMISTRY: PRELIMINARY FINDINGS
B. N. Khare and Carl Sagan Jul. 1971 17 p refs
(Grant NGR-33-010-101)
(NASA-CR-124646; CRSR-454) Avail: NTIS CSCL 03B

Pn a simulation of interstellar organic chemistry in dense interstellar clouds or on grain surfaces, formaldehyde, water vapor, ammonia and ethane are deposited on a quartz cold finger and ultraviolet-irradiated in high vacuum at 77K. The HCHO photolytic pathway which produces an aldehyde radical and a superthermal hydrogen atom initiates solid phase chain reactions leading to a ramge of new compounds, including methanol, ethanol, acetaldehyde, acetonitrile, acetone, methyl formate, and possibly formic acid. Higher nitriles are anticipated. Genetic relations among these interstellar organic molecules (e.g., the Cannizzaro and Tischenko reactions) must exist. Some of them, rather than being synthesized from smaller molecules, may be degradation products of larger organic molecules, such as hexamethylene tetramine, which are candidate consituents of the interstellar grains. The experiments reported here may also be relevant to cometary chemistry.
Author

N72-12069# National Research Council of Canada, Ottawa (Ontario).
ELECTROCHEMICAL METHOD FOR THE DETERMINATION OF KINETIC DATA, ESPECIALLY DIFFUSION COEFFICIENTS AND INTERFACIAL REACTION CONSTANTS, IN AND ON SOLID MATERIALS
H. Schmalzried 1971 12 p refs Transl. into ENGLISH from Arch. Eisenhuettenw. (West Germany), v. 39, no. 7, 1968 p 531-533
(NRC-TT-1492) Avail: NTIS

The basic possibilities of using solid state galvanic cells to measure kinetic data, as well as diffusion coefficients and interfacial reaction constants, are explored. An electrochemical method, divided into nonsteady and steady states, is used. Electrochemical measurements with double cells, for predetermining the activities of the dissolved substance at two intefaces of the phases to be studied used to eliminated chemical determination of such activities.
Author

N72-12070*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF SOME WIDE DYNAMIC RANGE READOUT SYSTEMS FOR PHOTOELECTRIC INTEGRATING SPECTROMETERS
Michael L. Franklin and William A. Gordon Washington Dec. 1971 21 p refs
(NASA-TM-X-2443; E-6527) Avail: NTIS CSCL 20F

Five types of electronic circuits commonly used for readout of currents from photomultiplier tubes were evaluated. This evaluation was conducted to define the experimental limits of achievimg the widest possible dynamic range of light detection and voncentration measurements in spectrochemical analysis. The circuits evaluated included the photon-counting technique and four dc circuits. These circuits displayed a dynamic range from 3 to about 4.5 decades within a repeatability criterion of 1 percent, or better. The maximum dynamic range allowed by the photomultiplier tube in this application was estimated to be about 6 decades.
Author

N72-12071# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Chemistry.
NUCLEAR CHEMISTRY AND GEOCHEMISTRY RESEARCH Progress Report, 1970-1971
Truman P. Kohman and Paul J. Karol 31 May 1971 69 p refs
(Contract AT(30-1)-844)
(NYO-844-84) Avail: NTIS

Research projects in nuclear chemistry and geochemistry are presented. Subjects discussed are: (1) isotopic composition of lead and thallium in natural materials, (2) alpha spectroscopy of uranium in tektites, (3) neodymium-samarium separations for geochronological applications, (4) anomalous alpha activity in natural materials, (5) search for natural radioactivity of calcium, (6) development of position-sensitive proportional counter, (7) least square analysis of experimental alpha spectra, and (8) chronology of galactic heavy element nucleosynthesiy.
Author (NSA)

N72-12072# New Brunswick Lab. (AEC), N.J.
[TITRIMETRIC DETERMINATIONS AND ASSAYS OF NUCLEAR FUEL MATERIALS] Annual Progress Report, Jul. 1969 - Jun. 1970
Jun. 1971 94 p refs
(NBL-258; DR-1851) Avail: NTIS

The titrimetric method (ferrous ion reduction) for determining uranium was modified for the high precision assay of uranium metal. A precision of about 0.005% (coefficient of variation) can be obtained. The uranium (VI) can also be determined by a further modification of the same method enabling the uranium (VI) to be calculated by difference. This method of determining uranium was applied to the 10- and 20-mg levels. The method was also modified by substituting titration with electrogenerated vanadium (V) for the dichromate titration. The use of aged vanadyl sulfate solutions can cause significant errors in the analyses of small amounts of uranium. The routine use of solid vanadyl sulfate reagent is recommended. A procedure was developed to remove mercuric ion, without the use of hydrogen sulfide. Reduction by stannous chloride and filtration of the mercury and mercuric chloride provides a rapid and reliable separation.
Author (NSA)

N72-12073# Bendix Corp., Kansas City, Mo.
SYNTHESIS OF A LOW DENSITY RIGID EPOXY FOAM Final Report
Mar. 1971 29 p refs
(Contract AT(29-1)-613)
(BDX-613-407) Avail: NTIS

The various formulation routes investigated in the course of developing a one component rigid epoxy foam called Capoxyfoam 1 are discussed. As a back-up epoxy foam for Ablefoam 5, Capoxyfoam 1 is potentially useful as an encapsulant for the components of a new electronic assembly to be used in a missile. When compared to Ablefoam 5, Capoxyfoam 1 was found equal or superior to its counterpart in physical, electrical, and processing characteristics.
Author

N72-12074# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
STUDY OF THE STRUCTURE OF PHYSISORBED PHASES BY THERMODYNAMIC ANALYSIS OF STEPWISE ISOTHERMS OF KRYPTON, XENON, ARGON, AND METHANE ON THE CLEAVAGE FACE OF HALIDES HAVING A LAYER LIKE STRUCTURE Ph.D. Thesis - Paris Univ., Orsay, 22 May 1970
Yves Larher Mar. 1971 203 p In FRENCH
(CEA-R-4089) Avail: AEC Depository Libraries

Adsorption isotherms of argon, krypton, xenon, and methane on the cleavage plane of halides having a layer-like structure ($NiCl_2$, $CoCl_2$, $FeCl_2$, $CdCl_2$, $CdBr_2$, CdI_2, and PbI_2) were determined at various temperatures. In most cases, it is possible to prepare, by sublimation in a rapid current of inert gas, adsorbing powders of these halides, of which the grains have highly developed cleavage faces. The isotherms show steps corresponding to the formation of successive monomolecular layers by two-dimensional condensation. Derivation of formulas enabled a comparison to be made of the structures of the successively adsorbed monolayers and of the compact layers of the solid adsorbate in terms of their internal energies and their entropies. It is concluded that the first absorbed layer is the

(111) plane of solid adsorbate which becomes more loosely packed as the dimensional compatibility of the lattices of the adsorbent and adsorbate becomes poorer. (NSA)

N72-12075# Pennsylvania Univ., Philadelphia. Lab. for Research on the Structure of Matter.
THE ac JOSEPHSON EFFECT DETERMINATION OF E/H: A STANDARD OF ELECTROCHEMICAL POTENTIAL BASED ON MACROSCOPIC QUANTUM PHASE COHERENCE IN SUPERCONDUCTORS Ph.D. Thesis
T. F. Finnegan, A. Denenstein, and D. N. Langenberg 1971 128 p refs Sponsored in part by ARPA and NSF
(AD-726174) Avail: NTIS CSCL 14/2

An ac Josephson effect determination of e/h with significantly improved accuravy is reported. The precision of the measurement is determined by uncertainties associated with the comparison of a Josephson device voltage with the emf of an electrochemical standard cell voltage reference and is about 3 parts in 10 to the 8th power. This precision was made possible by use of Josephson devices at voltages above 10 mV and design and construction of two special voltage comparator instruments. The fwbrication and operation of the Josephson devices and the design and performance of the voltage comparators are discussed. Author (GRA)

N72-12076# Chicago Univ., Ill. Div. of Physical Sciences.
EXPANDED RESEARCH PROGRAM IN MATERIALS SCIENCES Annual Technical Report, 1 Jul. 1970 - 30 Jun. 191
15 Jul. 1971 79 p refs
(Contract DAHC15-67-C-0220)
(AD-728044; ATR-10) Avail: NTIS CSCL 11/7

The report summarizes the program of research in the Materials Sciences area at the University of Chicago during 1970-71. The research, although often interdisciplinary in character, was performed within the following administrative units of the Division of Physical Sciences: The James Franck Institute, The Department of Chemistry, The Department of Geophysical Sciences, and The Department of Physics. GRA

N72-12077# Army Missile Command, Redstone Arsenal, Ala. Ground Equipment and Materials Directorate.
THERMALLY STABLE ORGANOMETALLIC POLYMERS Progress Report
Shelba P. Brown 1 Jun. 1971 20 p refs
(DA Proj. 1T0-61101-A-91-A)
(AD-728157; RL-TR-71-4) Avail: NTIS CSCL 07/3

The need for thermally stable polymers capable of maintaining good mechanical properties in the vicinity of 1000F to be used as coatings, insulators, and adhesives for Army missiles has prompted an attempt to prepare highly metalated polymers containing ferrocene, carborane, and silicon. Eight metal-containing polymers have been prepared, three of which have theoretical metal contents of greater than fifty percent. The jeport marks the conclusion of the exploratory synthetic phase of tye program and the beginning of developmental synthetic studies. Author (GRA)

N72-12078# Naval Academy, Annapolis, Md.
EXCITATION OF OXYGEN ATOMS BY ELECTRONS
William Thomas Stevens 18 May 1971 41 p refs
(AD-728767; USNA-TSPR-22) Avail: NTIS CSCL 07/4

An electron beam suitable for excitation function measurement could not be produced by electronic breakdown of the oxygen gas. Adequate electronic breakdown of the gas (a continqous glow rather than a spark type discharge) occurred only at pressures above 50 microns. It was not possible to obtain a continuous or glow discharge at pressures below 50 microny. The limization to pressures above 50 microns prevented formation of a beam from the available electrons because of the short electron mean free path at these pressures. Author (GRA)

N72-12079# Naval Postgraduate School, Monterey, Calif.
THE KINETICS OF SUCCESSIVE AQUATION REACTIONS OF TETRAAMMINEPALLADIUM(II) ION M.S. Thesis
Williams Jennings DeBerry, Jr. Jun. 1971 92 p refs
(AD-728702) Avail: NTIS CSCL 07/2

Solutions of tetraamminepalladium(II) perchlorate were made up and analyzed. Acid hydrolysis reactions of tetraamminepalladium(II) ion were studied by ultraviolet spectroscopy. First order rate constants were evaluated for each step of the reaction series at various temperatures. Activation parameters were determined. Mechanisms for the consecutive reactions are proposed, and cis and trans effects are discussed. Author (GRA)

N72-11991# Joint Publications Research Service, Washington, D.C.
EFFECT OF MONOSACCHARIDES ON THE REACTION OF CONDENSATION OF FORMALDEHYDE INTO CARBOHYDRATES
V. A. Uspenskaya, O. V. Krylov, and Yu. Ye. Sinyak *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 9-18 refs (See N72-11989 03-04)
Avail: NTIS

N72-11993# Joint Publications Research Service, Washington, D.C.
GROUP METHOD FOR ANALYSIS OF IMPURITIES IN REGENERATED WATER
V. A. Kryuchkov *In its* Space Biol. and Med., vol. 5, no. 4, 1971 3 Nov. 1971 p 27-34 refs (See N72-11989 03-04)
Avail: NTIS

N72-12042# Joint Publications Research Service, Washington, D.C.
HORIZONS OF CHEMICAL TECHNOLOGY
Viktor Vyacheslavovich Kafarov *In its* Future of Sci. 29 Oct. 1971 p 23-35 (See N72-12039 03-05)
Avail: NTIS

N72-12636# Jobin et Yvon S. A., Arcueil (France).
HOLOGRAPHIC DIFFRACTION GRATINGS [RESEAUX DE DIFFRACTION HOLOGRAPHIQUES]
G. Pieuchard, J. Flamand, J. Cordelle, and A. Labeyrie (Paris Obs.) *In* CNES 2nd Symp. on Optics 1969 p 30-41 refs In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N72-12080* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POSITION LOCATION SYSTEM AND METHOD Patent
Charles R. Laughlin and Roger C. Hollenbaugh, inventors (to NASA) Issued 20 Jul. 1971 11 p Filed 28 Nov. 1969 Continuation-in-part of US Patent Appl. SN-701744, filed 30 Jan. 1968 Supersedes N70-2-733 (08 - 08, p 1408)
(NASA-Case-GSC-10087-3; US-Patent-3,594,790; US-Patent-Appl-SN-880885; US-Patent-Class-343-6.8R; US-Patent-Class-325-4; US-Patent-Class-343-6.5R) Avail: US Patent Office CSCL 17B

A system and method for position locating for air traffic control are described. This includes communication via voice and

digital signals between remote aircraft, especially supersonic transports, and a central station, as well as peripheral ground station(s), through a synchronous satellite relay station. Side tone ranging patterns and the voice and digital signals are modulated on a carrier transmitted from the central station and received on all of the aircraft. Each aircraft communicates with the ground station via a different frequency multiplexed spectrum. Aircraft position is derived from a computer at the central station and supplied to a local air traffic controller. Position is determined in response to variable phase information imposed on the side tones at the airplanes, with a plurality of different side tone techniques, and relayed back to the transports. Common to all the side tone techniques is Doppler compensation for the supersonic transport velocity.

Official Gazette of the U.S. Patent Office

N72-12081* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FACSIMILE VIDEO REMODULATION NETWORK Patent

Charles H. Vermillion, inventor (to NASA) Issued 28 Jun. 1971 6 p Filed 29 May 1968

(NASA-Case-GSC-10185-1; US-Patent-3,588,331; US-Patent-Appl-SN-733039; US-Patent-Class-178-6; US-Patent-Class-178-DIG.12; US-Patent-Class-178-7.3; US-Patent-Class-325-13; US-Patent-Class-325-10) Avail: US Patent Office CSCL 17B

An apparatus is described for restoring and improving facsimile video signals that have been degraded prior to reception. The incoming video signal is demodulated and applied to a linear differential amplifier circuit and to a control circuit connected in parallel with the linear differential amplifier circuit. The control circuit controls the restoring of the demodulated signal by linearly controlling the black level of the video signal or by nonlinearly controlling the difference between the black and white levels of the video signal passing through the linear differential amplifier. The invention also includes means for detecting the frequency of video carrier signal and using the detected signal to control a switching network. The switching network switches its output at the frequency of and coherently with the incoming signal. The output of the switching circuit modulates the restored video signal in a modulator. Hence, the output from modulator is a restored video signal having a carrier frequency that is the same as the carrier frequency of the unrestored (incoming) video signal.

Offical Gazette of the U.S. Patent Office

N72-12082*# ADCOM, Inc., Cambridge, Mass.

DESIGN AND PERFORMANCE EVALUATION OF A WIDEBAND FM SPREAD-SPECTRUM MULTIPLE-ACCESS SYSTEM Final Report, Mar. - Jul. 1971

Richard H. Wachsman and Ahmad F. Ghais Jul. 1971 211 p refs

(Contract NAS5-20225)

(NASA-CR-122290; G-181-F) Avail: NTIS CSCL 17B

The system described performs the tracking and communications functions of a tracking and data relay satellite system (TDRS). The spread-spectrum signal format is achieved through wide deviation FM by a sinusoidal subcarrier unique to each multiple-access user. A compound phase-locked loop tracks carrier and subcarrier and demodulates data and ranging signals. Design parameters of user and ground terminals for TDRS are given. Acquisition procedures are described. Performance analyses are presented including the effects of noise, RFI, multipath and other users. Author

N72-12083*# National Aeronautics and Space Administration, Washington, D.C.

ELECTRONIC SIGNAL GENERATORS: A COMPILATION Technology Utilization

[1971] 25 p refs

(NASA-SP-5946(01)) Avail: NTIS CSCL 17B

Electronic signal generator data based on solid state concepts were simplified or refined to meet requirements, such as reliability, simplicity, fail-safe characteristics, and the capability of withstanding environmental extremes. Pulse generators, high voltage pulse generators, oscillators, analog signal generators, square wave signal generators, and special function signal generators are described. J.A.M.

N72-12084*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DUAL FREQUENCY (20.0-19.9 kHz) VLF DATA

C. H. Looney Jun. 1968 21 p refs

(NASA-TM-X-65755; X-540-68-220) Avail: NTIS CSCL 20N

Data are presented from 24 months of operation of radio station WWVL. Daily measurements of the 20.0 kHz and 20.0/19.9 kHz signal phase angles corrected in accordance with the NBS measurements are presented in tabular form. The 20.0/19.9 kHz data is a function of the phase angle of the 100 Hz information inherent in the 20.0/19.9 transmissions. This data can be used to resolve the 50 microsecond ambiguity inherent in 20.0 kHz single frequency transmissions. Author

N72-12085# Lockheed Missiles and Space Co., Palo Alto, Calif.

PECULIARITIES OF DIFFERENT PURPOSE RADAR UNITS

V. V. Grigorin-Riabov [1971] 15 p refs Transl. into ENGLISH from the book "Radiolokatsionnye Ustroistva (Teoriia i Printsipy Postroeniia)" Moscow, Sovetskoe Radio Press, 1970 p 522-541

Avail: NTIS National Translation Center, John Crerar Library, Chicago, Ill. 60616

Stations for ABM guidance, meteorology, mortar detection, and moving ground target detection are described. The fundamental tactical demands imposed on detection and guidance radar are considered. These include maximum operating range, survey sectors and period, accuracy of target coordinate measurement, and resolution. Detection and tracking radar systems are also discussed. K.P.D.

N72-12086*# ESL, Inc., Sunnyvale, Calif. Electromagnetic Systems Labs.

COMMUNICATION PERFORMANCE OVER THE TDRS MULTIPATH/INTERFERENCE CHANNEL

J. Jenny, D. Gaushell, and P. Shaft 19 Aug. 1971 99 p refs

(Contract NAS5-20228)

(NASA-CR-122295; ESL-TM239) Avail: NTIS CSCL 17B

Previously developed models are used to predict communication system performance for two cases: and aircraft/TDRS and a weather satellite/TDRS relay. The magnitude of multipath, differential time delay, Doppler shift, time and Doppler spread, and interference expected to be encountered are reviewed and applied to the two cases of interest. Author

N72-12087# National Aviation Facilities Experimental Center, Atlantic City, N.J.

VHF/UHF GROUND-AIR-GROUND COMMUNICATIONS SITING CRITERIA Final Report, Jul. 1967 - Dec. 1970

James G. Dong Nov. 1971 289 p refs

(FAA Proj. 221-110-17X)

(FAA-RD-71-76; FAA-NA-71-7) Avail: NTIS

Results are presented of tests accomplished at the National Aviation Facilities Experimental Center and selected Federal Aviation Administration field facilities to determine radio frequency communication problems and equipment performance under remote transmitter receiver and remote center air-ground configurations. Performance characteristics of antennas, transmitters, receivers, transmission lines, and ancillary equipment were investigated to determine the parameters that affect mutual interference when these equipments are combined in FAA system configurations. The results of the investigation were limited to equipment in current use at field sites and equipment recently developed. The data are incorporated in a field manual which was prepared to provide reference and guidance to installation and maintenance personnel on interference aspects in correcting similar problems at existing sites and the application of these principles in establishing new sites. Author

N72-12088# Lockheed Missiles and Space Co., Palo Alto, Calif.
RADAR SIGNAL DETECTION
V. V. Grigorin-Riabov, ed. [1971] 37 p refs Transl. into ENGLISH from the book "Radiolokatsionnye Ustroistva (Teoriia i Printsipy Postroeniia)" Moscow, Sovetskoe Radio Press, 1970 p 96-145
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The basic principles of signal detection are discussed. Detection characteristics of radar signals with known parameters and of signals with unknown initial phase are presented mathematically. K.P.D.

N72-12089*# Dayton Univ. Research Inst., Ohio.
OPTIMUM RADARS AND FILTERS FOR THE PASSIVE SPHERE SYSTEM
James K. Luers and Aaron Soltes (Raytheon Co., Lexington, Mass.) [1971] 138 p refs
(Contract NAS1-10329)
(NASA-CR-111952) Avail: NTIS CSCL 17I

Studies have been conducted to determine the influence of the tracking radar and data reduction technique on the accuracy of the meteorological measurements made in the 30 to 100 kilometer altitude region by the ROBIN passive falling sphere. A survey of accuracy requirements was made of agencies interested in data from this region of the atmosphere. In light of these requirements, various types of radars were evaluated to determine the tracking system most applicable to the ROBIN, and methods were developed to compute the errors in wind and density that arise from noise errors in the radar supplied data. The effects of launch conditions on the measurements were also examined. Conclusions and recommendations have been made concerning the optimum tracking and data reduction techniques for the ROBIN falling sphere system. Author

N72-12090# Australian Post Office Research Labs., Melbourne.
A DIGITAL PHASEABLE CLOCK AND TIME CODE GENERATOR: TSG-3
I. P. MacFarlane Jan. 1971 95 p refs
(Rept-6477) Avail: NTIS

The design and development of a Time Signal Generator (TSG-3) are described. From a 1 MHz input from a frequency standard it provides a multitude of outputs including once per second tone bursts, relay control signals for automatic announcing machines, marker and premarker pulses phaseable with respect to other outputs, once per second pulses and 10 kHz pulses. The epoch of the pulses and tone bursts can be readily advanced or retarded in multiples of 1 microsecond by amounts up to 999999 microseconds. Two TSG-3's are provided in the new VNG service. Author

N72-12091# Joint Publications Research Service, Washington, D.C.
SATELLITE COMMUNICATIONS SYSTEMS
Nikolay Ivanovich Kalashnikov 17 Nov. 1971 65 p refs Transl. into ENGLISH from Sistemy Svyazi Cherez Iskusstvennyye Sputniki Zemli (Moscow), 1969 p 151-159, 287-307, 313-319, 320-341
(JPRS-54505; UDC-621.396.946; CSO-1850-W) Avail: NTIS

The construction principles of a channeling apparatus for transmitting television and sound signals are discussed. Transmitting and receiving devices at ground stations, secondary ground equipment systems, and ground stations for the Molniya 1 and Orbita communications systems are considered. Receiving, transmitting, and antenna systems on board communications satellites are evaluated. Special reference is made to the Molniya 1 on-board equipment. The basic characteristics of satellite communication systems used in the U.S.S.R. and U.S. are tabulated. Author

N72-12092*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
COMMUNICATION THEORY OF QUANTUM SYSTEMS Ph.D. Thesis, 1970
Horace P. H. Yuen 30 Aug. 1971 187 p refs
(Grant NGL-22-009-013)
(NASA-CR-124632; TR-482) Avail: NTIS CSCL 09C

Communication theory problems incorporating quantum effects for optical-frequency applications are discussed. Under suitable conditions, a unique quantum channel model corresponding to a given classical space-time varying linear random channel is established. A procedure is described by which a proper density-operator representation applicable to any receiver configuration can be constructed directly from the channel output field. Some examples illustrating the application of our methods to the development of optical quantum channel representations are given. Optimizations of communication system performance under different criteria are considered. In particular, certain necessary and sufficient conditions on the optimal detector in M-ary quantum signal detection are derived. Some examples are presented. Parameter estimation and channel capacity are discussed briefly. Author

N72-12093*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RADIAL RIB ANTENNA SURFACE DEVIATION ANALYSIS PROGRAM
John V. Coyner, Jr. 15 Dec. 1971 70 p refs
(Contract NAS7-100)
(NASA-CR-124570; JPL-TM-33-518) Avail: NTIS CSCL 09A

A digital computer program was developed which analyzes any radial rib antenna with ribs radiating from a central hub. The program has the capability for calculating the antenna surface contour (reversed pillowing effect), the optimum rib shape for minimizing the rms surface error, and the actual rms surface error. Rib deflection due to mesh tension and catenary cable tension can also be compensated for, and the pattern from which the mesh gores are cut can be determined. Author

N72-12094*# City Coll. of the City of New York. Dept. of Electrical Engineering.
DELTA MODULATION Status Report, 1 Jan. - 1 Jul. 1971
Donald L. Schilling 1 Jul. 1971 37 p refs
(Grant NGR-33-013-063)
(NASA-CR-115282) Avail: NTIS CSCL 17B

An optimum adaptive delta modulator-demodulator configuration is derived. This device utilizes two past samples to obtain a step size which minimizes the mean square error for a Markov Gaussian source. The optimum system is compared using computer simulations with the linear delta modulator and an enhanced Abate delta modulator. In addition the performance is compared to the rate distortion bound for a Markov source. It is shown that the optimum delta modulator is neither quantization nor slope-overload limited. The results show that the output signal-to-noise ratio is independent of the input signal power and is subject only to the limitations of the hardware employed. In addition, voice was recorded using these systems. The demodulated voice indicates negligible degradation is caused by the optimum system and by the enhanced Abate system while the linear delta modulator suffers significant degradation at a sampling frequency of 56 kilobits/sec. Author

N72-12095*# TRW Systems Group, Redondo Beach, Calif. Electronic Systems Engineering Dept.
THE EFFECT OF SYSTEM NONLINEARITIES ON SYSTEM NOISE STATISTICS
L. H. Robinson, Jr. 20 Oct. 1971 41 p refs
(Contract NAS9-8166)
(NASA-CR-115245; TRW-17618-H223-R0-00; Task-707A) Avail: NTIS CSCL 17B

The effects are studied of nonlinearities in a baseline communications system on the system noise amplitude statistics. So that a meaningful identification of system nonlinearities can

be made, the baseline system is assumed to transmit a single biphase-modulated signal through a relay satellite to the receiving equipment. The significant nonlinearities thus identified include square-law or product devices (e.g., in the carrier reference recovery loops in the receivers), bandpass limiters, and traveling wave tube amplifiers. Author

N72-12096# Institute for Telecommunication Sciences, Boulder, Colo.
DEVELOPMENT OF THE 61.152 kHz SUBSYSTEM OF THE DECISION INFORMATION DISTRIBUTION SYSTEM
R. Marshall Coon, Hiroshi Akima, and Gene G. Ax Jul. 1971 69 p refs
(Contract DAHC20-69-C-0116)
(AD-728492; OT/ITSTM-44) Avail: NTIS CSCL 17/2

A feasibility model of a low-frequency subsystem for the Decision Information Distribution System (DIDS) was designed, developed, and successfully demonstrated. Based upon predetermined locations for ten primary receiver sites spaced rather uniformly throughout the contiguous United States, an optimum site was chosen for a 100 kW frequency-shift-keyed transmitter to operate at 61.152 kHz. A very unique and sophisticated bit synchronization technique had to be designed and developed for the transmitting and receiving system to meet very unusual operational restrictions. An optimum demodulator/decoder for a coded-binary noncoherent frequency-shift-keying (NCFSK) system was designed and developed to reduce required transmitter power to a minimum. An applicable scheme for signal acquisition was also developed. Laboratory tests indicated that experimental and theoretical performance agreed very closely. Very successful on-the-air tests tended to confirm the agreement. Author (GRA)

N72-12097# Eurospace, Paris (France).
THE POTENTIALITY OF SATELLITE SYSTEMS FOR MEETING FUTURE PRESS AND PUBLICATION REQUIREMENTS
Aug. 1971 55 p
Avail: NTIS

The use of a European communications satellite system for remote printing purposes was investigated on the basis of the views of the International Press Telecommunications Committee for the development of the newspaper and publishing industry. Certain requirements for channels, bandwidth, resolution, type of service, etc., emerged from a limited market survey, and a typical five link system was examined, using the Symphonie satellite under development for the pre-operational phase and the proposed CEPT satellite for the operational phase in the 1980's. Various transmission modes were assessed including the use of single or separate carriers and sequential or simultaneous page transmissions. From this preliminary assessment it appears that economically there is a strong case for the use of communication satellites, rather than conventional ground networks, in countries the size of France or Germany. For an area the size of Europe the benefits would be even more marked. ESRO

N72-12098# Danish Research Centre for Applied Electronics, Copenhagen.
SCREENING EFFICIENCY OF COAXIAL CABLES AT VHF: A MEASURING METHOD CONCERNING ELECTROMAGNETIC COUPLING INTO COAXIAL CABLES FROM NEAR-BY LINES AT VHF AND ITS THEORETICAL BACKGROUND
P. Krebs and J. Wested Jul. 1971 34 p refs Sponsored in part by Nord. Kabel- og Traedfabriker and Danish Post and Telegraph Admin.
(ECR-22) Avail: NTIS

A theoretical and experimental analysis of VHF interference in coaxial cables resulting from noise on parallel transmission or power lines is made. A practical method is described for measuring the screening efficiencies of coaxial cables to be used in community-antenna installations. In close connection with practical installations the theoretical investigation was restricted to one coaxial cable and one open, single line over a common ground plane, but with arbitrary loads on all ports, i.e. on line terminals and grounding points for the outer conductor. The cases include different propagation velocities inside and outside the coaxial cable. By using the theory of coupled transmission lines, explicit formulas for voltages and currents are found. The formulas are used in simplified cases to determine extremum values of the induced voltages. Couplings through the shielding braid between the disturbing line and the coaxial centre conductor are included in the analysis. A numerical example and an experiment for verification are discussed. The theory was developed to permit the prediction of the shielding efficiency of different coaxial cables, and in connection with the theory a practical method for comparing different cables was developed. Author (ESRO)

N72-12099# Raytheon Co., Sudbury, Mass. Equipment Div.
SUBSEQUENCE SYNC DESIGN Final Technical Report, Mar. - Nov. 1970
Richard J. Turyn and Jan Herman Jun. 1971 49 p refs
(Contract F30602-70-C-0146)
(AD-726101; RADC-TR-71-101) Avail: NTIS CSCL 09/4

The report is concerned with the determination of the phase of a binary sequence whose rule of formation is known but which has been received with errors. It is desired to determine the phase from a relatively short sequence. The authors describe what they call a predictive correlator, which represents a new approach to the correlation problem. It allows decisions on the phase of the incoming sequence in a much shorter time and with much simpler equipment than a conventional correlator, with better probability of success. Although the emphasis is on the m-sequences the idea is applicable to any binary sequence. The authors present the design of a predictive correlator, which would operate at a 10 nanosecond rate, and of all equipment which would be necessary for a laboratory demonstration of the feasibility of the scheme. In addition, the report discusses some results on the statistics of the weights of subsequences of an m-sequence. It is shown that the predictive correlator will provide synchronization on subsequences of length 500 for an m-sequence of length ((2 to the 23rd power)-1) with probability of missed synchronization and false synchronization more than two orders of magnitude less than the probability of error of the input pulses. Author (GRA)

N72-12100# Westinghouse Electric Corp., Baltimore, Md. Aerospace and Electronic Systems Div.
PULSE LEVELER INVESTIGATION Final Report, 1 Apr. 1970 - 1 Apr. 1971
Edward H. Hooper Griffiss Air Force Base, N. Y. RADC Jun. 1971 228 p refs
(Contract F30602-70-C-0098)
(AD-726100; RADC-TR-71-94) Avail: NTIS CSCL 09/5

This report covers an investigation of pulse leveling techniques applicable to high power radar modulators. It defines the problem areas in achieving precise pulse shape control in high voltage and high power pulse generation and presents techniques for overcoming the difficulties defined. Significant contributions are made to the state-of-the-art through the gathering together of diverse information into one place. The attainment of precise pulse control in a high power radar modulator is the result of careful attention to all facets of transmitter operation as well as the design of the modulator itself. The energy state and response time properties of the entire power system extending from the primary power source through the video circuit of the RF amplifier load are examined in detail in an analysis of their effect on total modulator performance. Techniques for improving modulator performance based on this analysis are described and representative designs for a line type and hard tube modulator pulsing a linear beam are outlined. Author (GRA)

N72-12101# Naval Underwater Systems Center, Newport, R.I. Design Review Div.
PREDICTION OF COUPLING, SHIELDING, AND GROUNDS

FOR LOW FREQUENCY FIELDS
Saul Shenfeld 2 Apr. 1971 168 p refs
(NUSC Proj. A-910-00-00; SF Proj. 03-532-003-02114)
(AD-726183; NUSC-4051) Avail: NTIS CSCL 20/14

An extensive review is made of formulas available in the literature for use in the prediction of electromagnetic interference in electronic systems. The theory of coupling, shielding, and grounding of cables, particularly at low frequencies, is presented along with charts that have been developed to aid in quick prediction of interference problems. The goal of the report is a compilation of sufficient background on this subject to permit a useful computer program to be developed for predicting interference problems in extensive electronic systems.
Author (GRA)

N72-12102# Advanced Technology Center, Inc., Dallas, Tex.
DIVER COMMUNICATION MICROPHONE DEVELOPMENT AND INSTALLATION Final Report
Charles T. Morrow May 1971 53 p
(Contract N00014-70-C-0313; NR Proj. 145-250)
(AD-726222; B-90000/1CR-14) Avail: NTIS CSCL 09/1

This is the final report on work performed under ONR Contract No. N00014-70-C-0313, to develop and install in two diving masks, a ceramic gradient microphone insensitive to mask cavity acoustics, essentially flat in pressure response to 10,000 Hz for use in deep submergence helium atmospheres, and capable of withstanding compression, decompression and intermittent flooding. The microphone and associated preamplifier were successfully developed. This development program potentially provides the Navy with a microphone that is insensitive to mask cavity acoustics, noise, and response deterioration of deep submergence atmospheres.
Author (GRA)

N72-12103# Office of Naval Research, London (England).
A BRITISH LONG RANGE SIDE-SCAN SONAR Conference Report
Richard O. Rowlands 15 Jul. 1971 7 p
(AD-728376; ONRL-R-26-71) Avail: NTIS CSCL 17/1

A description is given of a side scan sonar system developed by the British National Institute of Oceanography capable of operating at depths of up to 8000 meters and having a maximum range of twelve nautical miles.
Author (GRA)

N72-12104# Naval Research Lab., Washington, D.C.
AN AUTOMATICALLY CONTROLLED POWER SYSTEM FOR A COMMUNICATIONS BUOY Interim Report
Edward J. Kennedy 21 Jul. 1971 16 p refs
(SF Proj. 14-222-006-7461; NRL Proj. r01-15.201; NRL Proj. r01-15.203)
(AD-728384; NRL-7280; S-3203-11228) Avail: NTIS CSCL 10/2

The problem of supplying power to a remotely located communications buoy is complicated by several factors including relatively high tow-cable resistance, variation of this resistance with temperature, and the wide range of power required. Several methods for supplying this power are evaluated, leading to a discussion of an automatically controlled power system. This method, employing a remotely located error amplifier, provides excellent regulation with a minimum amount of complexity at the buoy. Several advantages of this system include insignificant power dissipation at the buoy, small size, and automatic adjustment to either varying load requirements or changing system parameters. Several fault-finding circuits are employed to protect the system from short circuit, loss of feedback information, and overheating.
Author (GRA)

N72-12105# Ohio State Univ., Columbus. Electroscience Lab.
TARGET IMAGING FROM MULTIPLE-FREQUENCY RADAR RETURNS
Jonathan D. Young Jun. 1971 196 p refs
(Grant AF-AFOSR-1710-69; AF Proj. 9769)
(AD-728235; ESL-2768-6; AFOSR-71-2166TR) Avail: NTIS CSCL 17/9

A new approach to synthetic target image generation from electromagnetic scattering measurements is described and illustrated. Complex harmonic samples of the back-scattered response at ten frequencies lying in the low resonance range of the target response spectrum are used as input data for this approach. A periodic ramp response waveform synthesized from these data is shown to be correlated to the cross sectional area vs distance along the line-of-sight, or profile function, of the targets measured. A technique using profile function data at three orthogonal target look angles for the mathematical specification of a three-dimensional (approximate limiting surface) is described. Visual images simulating an isometric view of the surface are then constructed.
Author (GRA)

N72-12106# Institute for Telecommunication Sciences, Boulder, Colo.
A DIGITAL LF ATMOSPHERIC RADIO NOISE SIMULATOR
Earl C. Bolton Jun. 1971 53 p refs
(AD-728493; OT/ITSTM-38) Avail: NTIS CSCL 14/2

Due to the non-stationary conditions involved during a period of thunderstorm activity it is often difficult to make a satisfactory performance evaluation of radio systems that may be affected by atmospheric radio noise. A digital atmospheric radio noise simulator has been developed that can be programmed to simulate a variety of amplitude-probability distributions and time probability distributions that are representative of atmospheric radio noise. Since the simulator has known statistics that are stationary it is useful in determining the performance of radio systems which may have to operate under the influence of random impulsive types of noise which is characteristic of atmospheric noise. The primary purpose of this memorandum is to give the details of the circuitry involved in the construction of the simulator.
Author (GRA)

N72-12107# Delaware Univ., Newark. Dept. of Mathematics.
RIGOROUS DIFFRACTION THEORY Interim Scientific Report, Jun. 1970 - Jun. 1971
Ralph E. Kleinman Jul. 1971 14 p refs
(Grant AF-AFOSR-1794-69B; AF Proj. 9749)
(AD-728228; AFOSR-71-2196TR) Avail: NTIS CSCL 20/14

The equivalent dipole moments of a perfectly conducting Rayleigh scatterer are expressed in terms of polarization and virtual mass tensors which are independent of the incident field. For bodies of revolution only three elements are needed to completely characterize low frequency electromagnetic scattering. Extension to penetrable objects is discussed and the necessary integral representations of the dipole moments are found. An integral equation formulation of a class of scattering problems involving smooth objects is shown to be soluble by standard iteration. Results are obtained analytically and numerically for a variety of obstacle configurations.
Author (GRA)

N72-12108# Naval Academy, Annapolis, Md.
AN INVESTIGATION OF DIGITAL FILTERING TECHNIQUES TRIDENT SCHOLAR PROJECT REPORT
William L. Hatcher 28 May 1971 87 p
(AD-728763; USNA-TSPR-17) Avail: NTIS CSCL 17/1

In the study the digital computer used as a tool for signal processing. The problem was to find a method for the computer to locate the returning sonar pulse, echoing off a submarine, from background reverberation. To do this digital filters were programmed. Success came finally with the use of the Fast Fourier Transform algorithm. With its use, a sonar operator would know the following properties of the echo: Doppler shift, intensity range. The Doppler shift gives the relative velocity of the target allowing the operator to determine where in range the echo should appear on following returns. As the operator integrates the echoes with past echoes using range and velocity the probabilities of the echo being from a submarine rises while the probability of the echo being noise tends to reduce to zero.
Author (GRA)

N72-12109# Stanford Research Inst., Menlo Park, Calif.
EVALUATION OF COMMUNICATION SYSTEMS OPERATING IN A DYNAMIC MODE Final Report
Manchi S. Colah and Robert W. Strunk Jun. 1971 120 p refs (Contract DAHC20-67-C-0136; SRI Proj. 6300-710; OCA Proj. 2211E)
(AD-728130) Avail: NTIS CSCL 17/2

The study deals with a general methodology for evaluating the throughput of civil defense (CD) communication systems at the local level using a statistical approach based on Poisson and exponential distributions. Two models are presented for simple queue discipline with no priorities, one pertaining to a single message-processing man/machine combination at a node, and the other to several man/machine combinations operating in parallel. Equations and working curves with normalized parameters are presented, permitting general application. From these, relevant items of interest - such as the mean length of messages in queue at a node, the mean delay in the queue, the probability of occurrence of various delays and queue lengths, and so forth - can be obtained. The methods of procedure for analysis are illustrated with numerical examples. Author (GRA)

N72-12110# Naval Research Lab., Washington, D.C. Operations Research Group.
A STARTING ALGORITHM FOR MINIMAL COST SURVIVABLE NETWORKS Final Report
Alvin B. Owens 15 Jul. 1971 13 p refs
(NRL Proj. B01-10; RR Proj. 003-02-41-6153)
(AD-728744; ORG-71-3; NRL-7272) Avail: NTIS CSCL 17/2

It is assumed that a network will be attacked by an all-knowing, intelligent enemy who will expend minimum effort to break communications in the network. An algorithm is presented which designs a near minimum cost network with specified incidences at each node. Author (GRA)

N72-11927# Army Electronics Command, Fort Monmouth, N.J.
TERRAIN AVOIDANCE RADAR FOR US ARMY
Otto H. Schoenberger *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 14 p refs (See N72-11915 03-02)
Avail: NTIS

N72-12290*# Kansas Univ./Center for Research, Inc., Lawrence.
REMOTE SENSING AT THE UNIVERSITY OF KANSAS IN RADAR SYSTEMS
Richard K. Moore *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 39 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 17I

N72-12291*# Kansas Univ./Center for Research, Inc., Lawrence.
RECENT ADVANCES IN RADAR APPLICATIONS TO AGRICULTURE
Stanley A. Morain *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 27 p refs (See N72-12269 03-13)
(Contract NAS9-10261)
Avail: NTIS HC $9.00/MF $0.95 CSCL 17I

N72-12292*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
INTERACTIVE DISPLAY/GRAPHICS SYSTEMS FOR REMOTE SENSOR DATA ANALYSIS
W. G. Eppler, D. L. Loe, E. L. Wilson, S. L. Whitley, and R. J. Sachen *In* Its 3d Ann. Earth Resources Program Rev., Vol. 2 1970 p 19 refs Prepared in cooperation with Lockheed Electronics Co., Houston, Tex. (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 17B

N72-12316*# Naval Research Lab., Washington, D.C.
THE VARIATION OF RADAR CROSS SECTION WITH WIND
N. W. Guinard *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 1 p (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 17I

N72-12317*# Naval Research Lab., Washington, D.C. E. O. Hulburt Center for Space Research.
NANOSECOND RADAR OBSERVATIONS OF THE OCEAN SURFACE FROM A STABLE PLATFORM
B. S. Yaplee, A. Shapiro, B. D. Au, D. L. Hammond, and E. A. Uliana *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 15 p (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 17I

N72-12172# Joint Publications Research Service, Washington, D.C.
CONTROL AND RESULTS OF PROGRAM IMPLEMENTATION
A. A. Aleksandrov, P. A. Artemyev, G. I. Bofatov, I. A. Yelenov, O. G. Ivanov, V. A. Ryvkina, Ye. G. Uzkiy, A. I. Shakhov, F. P. Pavlov, Yu. P. Kotlov et al *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 47-74 (See N72-12168 03-11)
Avail: NTIS

N72-12173# Joint Publications Research Service, Washington, D.C.
DESIGN CHARACTERISTICS AND PRINCIPAL PARAMETERS OF LUNOKHOD-1 TELEVISION SYSTEMS
A. S. Selivanov, V. M. Govorov, V. V. Zasetskiy, and V. A. Timokhin *In its* Lunkhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 75-96 refs (See N72-12168 03-11)
Avail: NTIS

08 COMPUTERS

Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics

N72-12111*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEVELOPMENT AND TESTING OF THE DATA AUTOMATION SUBSYSTEM FOR THE MARINER MARS 1971 SPACECRAFT
15 Nov. 1971 29 p refs
(Contract NAS7-100)
(NASA-CR-124577; JPL-TM-33-508) Avail: NTIS CSCL 09B

The data automation subsystem designed and built as part of the Mariner Mars 1971 program, sequences and controls the science instruments and formats all science data. A description of the subsystem with emphasis on major changes relative to Mariner Mars 1969 is presented. In addition, the complete test phase is described. Author

N72-12112*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GRAPHIC DISPLAYS FOR LARGE AERODYNAMIC TEST FACILITIES
Daniel L. Whipple Nov. 1971 13 p refs
(NASA-TM-X-67968; E-6474) Avail: NTIS CSCL 09B

A combination of software and hardware for a time-sharing computer is described which allows the user to obtain an on-line data display in the control room of a large research facility. Display and hard copy of alphanumeric data as well as graphical

data can be obtained as desired by the user. In addition, a number of utility programs provide for on-line graphic editing, program control, data manipulation, and off-line microfilm processing. Author

N72-12113*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A STUDY OF THE NORDSIECK-TYPE PREDICTOR-CORRECTOR METHODS
Howard M. Eiserike and Allan D. Silver Nov. 1971 29 p refs
(NASA-TM-X-63930; X-641-70-199) Avail: NTIS CSCL 09B

Predictor-corrector schemes are discussed for the numerical integration of initial value problems by computer. Descloux formulas, which are considered modified Nordsieck formulas are studied because of their desirable stability and truncation properties along with the standard Nordsieck formulas. The stability of Nordsieck and modified Nordsieck algorithms are computed, and the results are graphed. Test problems are included as examples for comparing the efficiency of the algorithms. F.O.S.

N72-12114*# Maryland Univ., College Park.
AN ADAPTIVE APPROACH TO THE DYNAMIC ALLOCATION OF BUFFER STORAGE M.S. Thesis
Sarah Catherine Crooke 1970 86 p refs
(Grants NGR-21-002-197; NGL-21-002-008)
(NASA-CR-122297) Avail: NTIS CSCL 09B

Several strategies for the dynamic allocation of buffer storage are simulated and compared. The basic algorithms investigated, using actual statistics observed in the Univac 1108 EXEC 8 System, include the buddy method and the first-fit method. Modifications are made to the basic methods in an effort to improve and to measure allocation performance. A simulation model of an adaptive strategy is developed which permits interchanging the two different methods, the buddy and the first-fit methods with some modifications. Using an adaptive strategy, each method may be employed in the statistical environment in which its performance is superior to the other method. Author

N72-12115*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIGITAL TAPE UNIT TEST FACILITY SOFTWARE
John T. Jackson Aug. 1971 37 p refs
(NASA-TM-X-65763; X-565-71-357) Avail: NTIS CSCL 09B

Two computer programs are described which are used for the collection and analysis of data from the digital tape unit test facility (DTUTF). The data are the recorded results of skew tests made on magnetic digital tapes which are used on computers as input/output media. The results of each tape test are keypunched onto an 80 column computer card. The format of the card is checked and the card image is stored on a master summary tape via the DTUTF card checking and tape updating system. The master summary tape containing the results of all the tape tests is then used for analysis as input to the DTUTF histogram generating system which produces a histogram of skew vs. date for selected data, followed by some statistical analysis of the data. Author

N72-12116*# Computer Sciences Corp., Huntsville, Ala.
FORMAC INTEGRATION PROGRAM: A SPECIAL APPLICATIONS PACKAGE USED IN DEVELOPING TECHNIQUES OF ORBITAL DECAY AND LONG TERM EPHEMERIS PREDICTION FOR SATELLITES IN EARTH ORBIT
C. K. Rowe Nov. 1971 46 p
(Contract NAS8-26113)
(NASA-CR-121054) Avail: NTIS CSCL 09B

The symbolic manipulation capabilities of the FORMAC (Formula Manipulation Compiler) language are employed to expand and analytically evaluate integrals. The program integration is effected by expanding the integral(s) into a series of subintegrals and then substituting a pre-derived and pre-coded solution for that particular subintegral. Derivation of the integral solutions necessary for precoding is included, as is a discussion of the FORMAC system limitations encountered in the programming effort. Author

N72-12117*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DALG: A PROGRAM FOR TEST PATTERN GENERATION IN COMBINATIONAL LOGICAL CIRCUITS
15 Nov. 1971 45 p refs
(Contract NAS7-100)
(NASA-CR-124571; JPL-TM-33-516) Avail: NTIS CSCL 09B

A user's manual for a computer program DALG which generates test patterns for detecting faults in combinational logic circuits containing up to 200 logical gates is presented. The gates may be of logical types AND, OR, NAND, NOR, NOT, or Exclusive OR is presented. The faults may be any one gate or input struck at a fixed value (0 or 1). In addition to test pattern generation DALG will also determine whether or not the given test pattern will detect given faults in a circuit. Sample problems are given along with input data sheets and printed output to illustrate the capabilities of the program. Author

N72-12118*# Computer Sciences Corp., Huntsville, Ala.
SPACEBORNE COMPUTER EXECUTIVE ROUTINE FUNCTIONAL DESIGN SPECIFICATION. VOLUME 1: FUNCTIONAL DESIGN OF A FLIGHT COMPUTER EXECUTIVE PROGRAM FOR THE REUSABLE SHUTTLE
R. T. Curran Washington NASA Oct. 1971 175 p refs
(Contract NAS8-24930)
(NASA-CR-1867) Avail: NTIS CSCL 09B

A flight computer functional executive design for the reusable shuttle is presented. The design is given in the form of functional flowcharts and prose description. Techniques utilized in the regulation of process flow to accomplish activation, resource allocation, suspension, termination, and error masking based on process primitives are considered. Preliminary estimates of main storage utilization by the Executive are furnished. Conclusions and recommendations for timely, effective software-hardware integration in the reusable shuttle avionics system are proposed. Author

N72-12119# Smithsonian Astrophysical Observatory, Cambridge, Mass.
ATLAS: A COMPUTER PROGRAM FOR CALCULATING MODEL STELLAR ATMOSPHERES
Robert L. Kurucz 3 Mar. 1970 302 p refs
(SAO-Special-Rept-309; Rept-106-048) Avail: NTIS HC $6.00/MF $0.95

The ATLAS computer program calculates model stellar atmospheres in radiative and convective equilibrium for the complete range of stellar temperatures. The approximations used limit the program to plane-parallel, horizontally homogeneous, steady state, nonmoving atmospheres with energy and abundances constant with depth. The program permits detailed statistical equilibrium calculations for hydrogen continua and H(-). Most published continuous opacities and hydrogen lines are included. There is also provision for treating line opacity as line-absorption distribution functions. All aspects of model atmosphere calculations are discussed, including radiation field, statistical equilibrium, thermodynamic properties, opacity, convection, and temperature correction. Author

N72-12120*# Maryland Univ., College Park. Computer Science Center.
CDL DESCRIPTION OF THE CDC 6600 STUNT BOX
Jon B. Hertzog Sep. 1971 24 p refs
(Grant NGR-21-002-206)
(NASA-CR-122309; TR-169) Avail: NTIS CSCL 09B

The CDC 6600 central memory control (stunt box) is described utilizing CDL (Computer Design Language), block

diagrams, and text. The stunt box is a clearing house for all central memory references from the 6600 central and peripheral processors. Since memory requests can be issued simultaneously, the stunt box must be capable of assigning priorities to requests, of labeling requests so that the data will be distributed correctly, and of remembering rejected addresses due to memory conflicts. Author

N72-12121*# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
THE EFFECT OF TIMING ERRORS IN OPTICAL DIGITAL SYSTEMS Interim Technical Report
R. Gagliardi Aug. 1971 19 p refs
(Grant NGR-05-018-104)
(NASA-CR-122305; USCEE-406) Avail: NTIS CSCL 09B

The effects of imperfect timing in direct detection (non-coherent) optical binary systems using both PPM and on-off keying for bit transmission are investigated. Particular emphasis is placed on specification of timing accuracy, and an examination of system degradation when this accuracy is not attained. Bit error probabilities are shown as a function of timing errors, from which average error probabilities can be computed for specific synchronization methods. Of significant importance is the presence of a residual, or irreducible error probability in both systems, due entirely to the timing system, that cannot be overcome by the data channel. Author

N72-12122# National Bureau of Standards, Washington, D.C. Statistical Engineering Lab.
OMNITAB 2 USER'S REFERENCE MANUAL
David Hogben, Sally T. Peavy, and Ruth N. Varney Oct. 1971 264 p refs
(NBS-TN-552) Avail: SOD $2.00 Catalogue No. 0303-0918

OMNITAB II, a highly user-oriented system for a large computer, is designed to make computing easy, accurate and effective, particularly for persons who are not programmers. It is a general purpose program, which can be learned quickly, for both simple and complex numerical, statistical and data analysis. OMNITAB executes instructions written in the form of simple English sentences. Problem solving is further enhanced by the natural structure of the system and its many features. The system has been implemented on large computers of at least seven different manufacturers. The original version of OMNITAB has been completely rewritten to make it as machine independent as possible and to implement many improvements. This manual describes Version 5.0. Author

N72-12123*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
SUBSTRUCTURING TECHNIQUES
W. D. Whetstone and C. E. Jones Oct. 1971 25 p refs
(Contract NAS8-30520)
(NASA-CR-121051; LMSC/HREC-D162799-A; LMSC-TM-54/50-153) Avail: NTIS CSCL 09B

The substructure function generator program is discussed. Input to this program consists of a definition of a finite element model of a substructure, and specification of the type and number of displacement functions to be generated. Primary output is a substructure data file containing the substructure mass and stiffness matrices expressing kinetic and potential energies as quadratic forms in coefficients of the displacement functions, etc. The substructure synthesis program forms complete system mass, stiffness, and damping matrices, computes system modes and frequencies, and executes transient response calculations. Input to this program consists of the array of substructure data files generated by the function generator program for individual substructures, and data cards defining the position and interconnection of the substructures, damping data, forcing function details, and function control parameters. Author

N72-12124*# TRW Systems Group, Redondo Beach, Calif.
APOLLO CRYOGENIC INTEGRATED SYSTEMS PROGRAM PROGRAMMER'S GUIDE
R. K. M. Seto Nov. 1971 198 p refs
(Contract NAS9-8166)
(NASA-CR-115279; TRW-17618-H229-R0-00; MSC-TRW-Task-e-98A) Avail: NTIS CSCL 09B

The subroutine calling sequence, subroutine descriptions, and flow charts are presented. The program is capable of simulating both nominal and anomalous operation of the Apollo cryogenic storage system and is operational on the Univac 1108 computer. Author

N72-12125# Royal Aircraft Establishment, Farnborough (England).
A GUIDE TO CORAL PROGRAMMING
A. A. Callaway Jun. 1970 58 p refs
(RAE-TR-70102) Avail: NTIS

CORAL is a high-level programming language which is to a large extent machine independent. It is based broadly on ALGOL 60 but is extended and improved; no reference is made to similarities between CORAL and ALGOL. The basic constituents of the language are described, application to the writing of a simple program shown, language procedure structure and techniques for abbreviation discussed, and additional facilities mentioned. ESRO

N72-12126# Association des Ouvriers en Instruments de Precision, Paris (France).
ALGORITHM FOR LINEARITY PARAMETER PROCESSING FROM INDUSTRIAL MEASURES [ALGORITHME D'EXTRACTION D'UN PARAMETRE DE LINEARITE A PARTIR DE MESURES INDUSTRIELLES]
J. A. R. Miroux 30 Nov. 1970 57 p refs In FRENCH
Avail: NTIS

An algorithm was developed for computerized determination of the slope of the straight part of the electrical resistivity curve of electrolytes. The problem is to determine the point where the curve ceases to be a straight line. The algorithm enables the determination of the position of this point with precision, the computation being done on a progressive number of values starting with the smallest values. It is based on a comparison between the slope of the straight line including the n first points, with the mean value of the slope calculated for the preceding points n-1, n-2, etc. ESRO

N72-12127# Admiralty Surface Weapons Establishment, Portsmouth (England).
CORAL 66 LIBRARY PROCEDURES FOR MECSL 900 COMPUTERS
M. H. A. Smith Mar. 1971 132 p
(AD-729704; ASWE-TR-71-15; NSTIC-30367) Avail: NTIS CSCL 09/2

Thirty-nine general library procedures are presented which, although written in CORAL 66 for use on the MECSL 900 range of computers, should be readily transferable to any other machine. For each procedure there is given a description, the CORAL text, and the compiled code. Author (GRA)

N72-12128# Naval Postgraduate School, Monterey, Calif.
XPL CGP: AN XPL-BASED SEMANTIC LANGUAGE PROCESSOR M.S. Thesis
Peter Charles Finne Jun. 1971 272 p refs
(AD-728565) Avail: NTIS CSCL 09/2

The XPL CGP is a complete compiler generator package based on the XPL system. With the introduction of a semantic meta-language (SML) and an associated processor, the package is capable of generating a production compiler for any computer language with a mixed strategy precedence grammar. The only input required in most cases is the syntax of the language encoded in BNF and the corresponding semantics encoded in SML. The resulting compiler will generate code which may be executed on a simulated stack-oriented machine. Author (GRA)

N72-12129# Naval Postgraduate School, Monterey, Calif.
A MODULAR INTERFACE DESIGN FOR A SMALL DIGITAL COMPUTER IN A HUMAN ENGINEERING LABORATORY
M.S. Thesis
Paul Ray Gaddie Jun. 1971 51 p refs
(AD-728662) Avail: NTIS CSCL 09/2

The design of a system interface for a PDP 8/E computer system and the research instruments of the Human Engineering Laboratory at the Naval Postgraduate School is discussed. Emphasis is on the digital logic where a modular approach is used. Each module is a common grouping of logic elements for performing a particular function. Seven function modules are described, and their integration into a complete system is discussed. It is intended that the equipment be built and the system tested in the near future. Author (GRA)

N72-12130# Air Force Systems Command, Edwards AFB, Calif. Rocket Propulsion Lab.
REVISED PLOTTING CAPABILITY FOR THE 2-D FLAT EARTH TRAJECTORY COMPUTER PROGRAM
Stewart W. Turner and Ray A. Dees Jun. 1971 29 p ref
(AD-728278; AFRPL-TR-71-77) Avail: NTIS CSCL 16/2

The report describes a computer program written to improve the plotting capability of an existing AFRPL computer program described in X69-15407. The report should be used in conjunction with the above document. The plot routine was written to permit plotted output on the CalComp plotter. The original plot routine had been designed for use on the Benson-Lehner Electroplotter II. Many of the features available in the original routine have been retained and several new features have been added. Author (GRA)

N72-12131# Army Foreign Science and Technology Center, Charlottesville, Va.
ONE DEVICE FOR COUPLING UNIVERSAL STEREOPHOTOGRAMMETRIC DEVICES TO DIGITAL COMPUTERS
Yu. F. Motienko, A. P. Orlov, and A. A. Chigirev 21 Jul. 1971 12 p refs Transl. into ENGLISH from Geod. Karografiya (USSR), no. 10, 1970 p 49-55
(AD-728533; FSTC-HT-23-880-71) Avail: NTIS CSCL 09/2

Coupling devices designed to connect universal stereophotogrammetric apparatus with computers are described. The devices are based on simple magnetic reading converters which operate by rotation of ferrites through a gap of variable width on a screw shaft. The devices provide good signal/noise ratio, low output impedence and satisfactory accuracy. Author (GRA)

N72-12132# Institute for Telecommunication Sciences, Boulder, Colo. Inst. for Telecommunication Sciences.
SIGNAL ACQUISITION IN THE DECISION INFORMATION DISTRIBUTION SYSTEM
Hiroshi Akima May 1971 33 p refs
(Contract DAHC20-69-C-0116)
(AD-728495; OT/ITSTM-39) Avail: NTIS CSCL 09/4

Decision procedures for signal acquisition in the Decision Information Distribution System (DIDS) are suggested, and a method of determining the required signal-to-noise ratio (SNR) for specified probabilities of false alarm, error, and miss is described. Here a low false-alarm probability is required, so that a message is more likely to be missed than to be received in error. A lower bound of the required SNR for this system is given. A decision procedure that has been implemented in a prototype receiver for the system is described. Author (GRA)

N72-12133# Institute for Telecommunication Sciences, Boulder, Colo.
PROPOSED CODE FOR THE DECISION INFORMATION DISTRIBUTION SYSTEM
Hiroshi Akima Apr. 1971 18 p
(Contract DAHC20-69-C-0116)
(AD-728494; OT/ITSTM-34) Avail: NTIS CSCL 09/4

A binary code that satisfies requirements for the Decision Information Distribution System (DIDS) is generated. Requirements for the code, procedure for generating such a code, and resulting code are described. Author (GRA)

N72-12134# Naval Postgraduate School, Monterey, Calif.
AN INTERACTIVE GRAPHICAL DEBUGGING SYSTEM
M.S. Thesis
Allan Warren Walker Jun. 1971 62 p
(AD-728711) Avail: NTIS CSCL 09/2

A system is described which provides an interactive graphical debugging facility for user programs. This system is implemented on an Adage AGT-10 and is operational for online debugging of higher-level language programs executing on an XDS 9300 host computer. System architecture and implementation are discussed. A formal definition of the DEBUG Command Language is given and a description of the utilization of the commands for program debugging is presented. Author (GRA)

N72-12040# Joint Publications Research Service, Washington, D.C.
COMPUTER ENGINEERING AND PROBLEMS OF AUTOMATION OF CONTROL
Viktor Mikhaylovich Glushkov *In its* Future of Sci. 29 Oct. 1971 p 1-11 (See N72-12039 03-05)
Avail: NTIS

N72-12287*# Michigan Univ., Ann Arbor. Willow Run Labs.
USER ORIENTED DATA PROCESSING AT THE UNIVERSITY OF MICHIGAN
Frederick J. Thomson *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 18 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 05B

N72-12294*# Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.
PHENOMENOLOGICAL APPROACH TO SCATTEROMETER DATA INTERPRETATION
F. E. Alzofon *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 8 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 05B

N72-12319*# New York Univ., N.Y. Dept. of Meteorology and Oceanography.
THE INTEGRATION OF REMOTE SENSING DATA INTO GLOBAL WEATHER PREDICTION, WAVE FORECASTING, AND OCEAN CIRCULATION COMPUTER BASED SYSTEMS
Willard J. Pierson, Jr. *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 27 p refs (See N72-12295 03-13)
(Contracts N62306-70-A-0075; N00014-67-A-0467-0012)
(Contrib-98) Avail: NTIS HC $6.00/MF $0.95 CSCL 09B

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N72-12135 National Lending Library for Science and Technology, Boston Spa (England).
A PULSE PATTERN GENERATOR WITH A MAXIMUM REPETITION RATE OF 1.4 GHz
A. Weber 22 Sep. 1971 7 p refs Transl. into ENGLISH from

NTZ - Nachr. Tech. Z., v. 24, no. 3, 1971 p 126-128 Published by VDE Verlag GmbH, Berlin
(NLL-PORS-Trans-2784-(9022.81)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A pulse pattern generator is described, which permits, due to its parallel working method (each pulse is produced and formed in its own unit), a pulse repetition rate up to 1.4 GHz. Each pulse can be varied continually in its amplitude, width and position. Therefore arbitrary pattern can be selected. For test purposes the device is equipped with a pseudorandom generator which switches the pulses statistically. Author

N72-12136* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INTEGRATED THERMOELECTRIC GENERATOR/SPACE ANTENNA COMBINATION Patent
Gerald L. Pucillo, inventor (to NASA) Issued 20 Jul. 1971 4 p Filed 29 Oct. 1968
(NASA-Case-XER-09521; US-Patent-3,594,803;
US-Patent-Appl-SN-771530; US-Patent-Class-343-720;
US-Patent-Class-343-DIG.3; US-Patent-Class-343-840;
US-Patent-Class-136-202; US-Patent-Class-136-206;
US-Patent-Class-136-227) Avail: US Patent Office CSCL 09E

An integrated thermoelectric generator/antenna is described. An antenna is formed of a sandwich of hot and cold thermoelectric elements, such as bismuth and tellurium. Power storage means are connected to the antenna to receive and store the power generated by the thermoelectric action between the elements. In addition, means are connected to the antenna so that the antenna transmits and receives signals. A separate source of heat is connected to the hot thermoelectric element to provide an auxiliary source of heat for that element when the antenna is not receiving energy from a hot body.
Offical Gazette of the U.S. Patent Office

N72-12137*# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF A HIGHLY RELIABLE COMPOSITE BOARD FOR PRINTED CIRCUITRY FOR USE IN SPACE ENVIRONMENT Final Report, 28 Jun. 1968 - 30 Oct. 1970
E. J. Bradbury, R. A. Markle, W. R. Dunnavant, and P. B. Stickney 30 Oct. 1971 52 p
(Contract NAS8-21424)
(NASA-CR-121022) Avail: NTIS CSCL 09D

Materials, processes and fabrication techniques have been investigated for the development of a high-temperature circuit-board laminate. High quality, void-free copper-clad laminates have been made using 7628/HS-1 style fiberglas reinforcements with filled polyimide matrices. The fabricating characteristics of P13N resin appear suitable for use as a filled matrix in this circuit board development. High-fired, ball-milled alumina appears to be necessary to obtain the desired effects in the circuit board system. Nickel-clad copper foil bonding surfaces appear to be another requirement for retention of good bond strengths after art work and plating sequences. The fabrication cycle for this circuit board system is very dependent on the heating profile. Very rapid heating with quick loading is recommended. A stack approach to lamination was successfully used. Author

N72-12138*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
REDUNDANCY MANAGEMENT OF ELECTROHYDRAULIC SERVOACTUATORS BY MATHEMATICAL MODEL REFERENCING
Richard A. Campbell 9 Nov. 1971 29 p
(NASA-TM-X-64625) Avail: NTIS CSCL 09E

A description of a mathematical model reference system is presented which provides redundancy management for an electrohydraulic servoactuator. The mathematical model includes a compensation network that calculates reference parameter perturbations induced by external disturbance forces. This is accomplished by using the measured pressure differential data taken from the physical system. This technique was experimentally verified by tests performed using the H-1 engine thrust vector control system for Saturn IB. The results of these tests are included in this report. It was concluded that this technique improves the tracking accuracy of the model reference system to the extent that redundancy management of electrohydraulic servosystems may be performed using this method. Author

N72-12139*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A 10.6 MICRON LASER-RECEIVER RF SUBSYSTEM
D. E. Santarpia and T. E. McGunigal Washington Nov. 1971 8 p refs
(NASA-TN-D-6535) Avail: NTIS CSCL 20E

One of the problems inherent in the use of optical communication systems is the exceedingly high Doppler shift which can be expected. With the recent development of stable, linear, octavebandwidth, voltage-tunable oscillators, this problem has been solved. A laboratory tracking receiver which is capable of tracking a 1-GHz frequency shift at rates up to 12 MHz/s with subsequent coherent data demodulation was designed and tested. This work demonstrates that the design and fabrication of an RF subsystem, utilizing coherent demodulation of data, for wideband communications systems is now both feasible and practical. Author

N72-12140# Technische Hochschule Hannover (West Germany). Fakultaet fuer Maschinenwesen.
THE EFFECTS OF EDDY FLOW IN THE STATOR CAGE AND ROTOR SHAFT ON THE PERFORMANCE BEHAVIOUR OF DIPOLAR SYNCHRONOUS ALTERNATING CURRENT MOTORS Ph.D. Thesis [DER EINFLUSS VON WIRBELSTROEMEN IM STAENDERGEHAEUSE UND IN DER LAEUFERWELLE AUF DAS BETRIEBSVERHALTEN ZWEIPOLIGER DREHSTROMASYNCHRONMOTOREN]
Herwart Buttkereit 1971 115 p refs In GERMAN
Avail: NTIS

A mathematical model is developed and used to analyze input impedance caused by the permeability of the solid iron shaft in dipolar alternative motors. These effects are incorporated in concentric layers corresponding to the geometrical dimensions of the machine so that each layer includes magnetic and electric properties as well as radial measurements. Fluctuations in magnetic resistance are considered by defining substitute permeabilities for the tangential and radial directions. Maxwellian calculations of magnetic field dimensions show that substitute permeabilities represent adequately the effects of grooving and cooling channels. Magnetic field line calculations for the rotor shaft show that homogeneous permeability takes place only at exact synchronous rotation. Minute slip values already develop strong eddy currents that displace magnetic flux from the rotation shaft and produce magnetic induction losses in the stator cage. Transl. by G.G.

N72-12141*# California Univ., Berkeley. Dept. of Electrical Engineering.
A FAST ALGORITHM FOR THE CALCULATION OF JUNCTION CAPACITANCE AND ITS APPLICATION FOR IMPURITY PROFILE DETERMINATION
Hugo J. J. DeMan 1971 41 p refs Sponsored partly by NASA and ESRO
(NASA-CR-124672) Avail: NTIS CSCL 09C

A fast algorithm is described which calculates the space charge layer width and junction capacitance for an arbitrary impurity profile and for plane, cylindrical and spherical junctions. The algorithm is based on the abrupt space charge edge (ASCE) approximation. A method to use the algorithm for the determination of impurity profiles for two-sided junctions is presented. An expression is derived for the built-in voltage to be used for capacitance calculations with the ASCE approximation. Experimental evidence is given that the algorithm permits very accurate capacitance calculations and also predicts the exact temperature dependence of the junction capacitance.
Author (ESRO)

N72-12142*# California Univ., Berkeley. Dept. of Electrical Engineering.
THE INFLUENCE OF DEGENERACY ON THE EMITTER EFFICIENCY OF A BIPOLAR TRANSISTOR
H. J. J. DeMan 1971 19 p refs Sponsored in part by NASA and ESRO
(NASA-CR-124674) Avail: NTIS CSCL 09A

An expression for the emitter efficiency is derived taking the degeneracy of the emitter into account. It is found that, even if there is no recombination of minority carriers in the emitter, degeneracy reduces the emitter efficiency. In addition this first order theory explains experimental results on temperature dependence of current gain and predicts an optimum emitter design for a fixed type of emitter profile. Author (ESRO)

N72-12143# Addis Translations International, Woodside, Calif.
MEASURING THE Q OF SUPERCONDUCTING RESONATORS WITH A TRAVELING-WAVE TUBE
A. I. Zykov, B. R. Knyazev, M. I. Kheifets, and A. D. Kuznetsov Feb. 1971 19 p refs Transl. into ENGLISH of Acad. Nauk SSSR, Kharkov report KhFTI-70-30 In ENGLISH and RUSSIAN Prepared for Calif. Univ., Berkeley. Lawrence Radiation Lab.
(UCRL-Trans-1437; KhFTI-70-30) Avail: NTIS

A method is described for measuring the loaded and natural Q of resonators. A UHF-power modulator circuit and connections are given. A method is proposed for measuring the UHF-oscillation damping decrement accurately to within 1%. Formulae are given for calculating the natural Q of re-entrant resonators. Results are reported of measurements of the Q of resonators with a superconducting coating of lead applied by cathode sputtering. Author (NSA)

N72-12144# Institute of Nuclear Research, Warsaw (Poland).
FIELD DISTRIBUTION MEASUREMENTS IN LINAC
W. Grabowski 1971 24 p refs In POLISH; ENGLISH summary
(INR-1273) Avail: AEC Depository Libraries

An analysis of Slater's equation concerning frequency perturbation in a 200 MHz resonance cavity was carried out. The conditions that must be maintained to reach the accuracy of Delta E/E less than 1% are specified. The method, experimental results, and error estimate are given. Author (NSA)

N72-12145# Joint Inst. for Nuclear Research, Dubna (USSR).
SOME SPECIFIC FEATURES OF THE COLD CATHODE OPERATING AT LOW PRESSURES
G. V. Dolbilov, V. P. Sarantsev, and A. P. Sumbaev 1971 24 p refs In RUSSIAN
(JINR-P9-5753) Avail: AEC Depository Libraries

The conditions of forming an intense gas-focusing electron beam from the cold cathode at pressures of 0.001 to 0.01 torr are investigated. The behavior of the beam near the metal surfaces is examined. The energetic structure of the current carriers is studied by the method of corpuscular diagnostics. Author (NSA)

N72-12146# Radio Corp. of America, Van Nuys, Calif. RCA Electromagnetic and Aviation Systems Div.
ON ARRAY LOGIC AND PHASE-SHIFTER DRIVER Quarterly Progress Report, 1 Oct. - 31 Dec. 1970
Norman G. Hempling and Robert J. Wayner May 1971 20 p
(Contract DAAB07-70-C-0238; DA Proj. 1H6-62705-A-440)
(AD-725581; TP-1999; ECOM-0238-2; QR-2) Avail: NTIS CSCL 09/5

The application of silicon integrated circuits to drivers for microwave latching phase shifters and on the array control logic is being investigated. Two monolithic integrated circuits, a P-MOS circuit for logic and a bipolar circuit for the analog driver have been designed and fabricated. The output drive circuit is capable of delivering a bidirectional current pulse of up to 5 amps through a latching ferrite element. Circuit performance has been excellent for both integrated circuits in the evaluation to date. Author (GRA)

N72-12147# Admiralty Surface Weapons Establishment, Portsmouth (England).
AN X-BAND LINEAR ARRAY WITH SELECTABLE POLARIZATION
A. C. Large Mar. 1971 14 p refs
(AD-729878; TR-71-13; NSTIC-29818) Avail: NTIS CSCL 09/5

A simple design for a slotted linear antenna array with selectable polarization was demonstrated. The array can be arranged to give vertically, horizontally, or circularly polarized radiation by the adjustment of a single phase changer. Author

N72-12148# Harry Diamond Labs., Washington, D.C.
CHARACTERISTICS OF BURIED LAYER TRANSISTORS
E. P. Dudley and G. B. Wetzel Aug. 1971 29 p refs
(DA Proj. 1T0-61102-B-31-A; HDL Proj. REL92)
(AD-728508; HDL-TR-1561) Avail: NTIS CSCL 09/1

Electrical characteristics including collector saturation resistance, collector-to-emitter breakdown voltage, and isolation breakdown voltage were determined for several groups of transistors made with high-conductivity layers of various sizes buried in the collector region. The base widths of these transistors were varied by varying the emitter diffusion time. Both gaseous and spin-on types of dopant sources were used for the diffusions obtaining the buried layers. Buried layers of three different sizes were used with isolation moats of the same size to determine the effect of layer area on collector saturation resistance and the effect of its proximity to the isolation moat on the isolation breakdown voltage. With the largest buried layers and two collector contacts, the collector saturation was decreased an order of magnitude, from about 1500 ohms. At the same time the isolation breakdown voltage measured greater then 40 V. For one group of transistors, an average current gain of 72 was realized with collector-to-emitter breakdown voltage of 50 V. Author (GRA)

N72-12149# IBM Watson Research Center, Yorktown Heights, N.Y.
INVESTIGATION OF HIGHLY-DOPED SCHOTTKY-BARRIER FIELD EFFECT TRANSISTORS
Karstein E. Drangeid 16 Dec. 1970 45 p refs
(Contract F19628-70-C-0094; AF Proj. 5710)
(AD-728635; AFCRL-71-0251; SR-2; DoD-Element-61102H; DoD-Subelement-689-20G-5520) Avail: NTIS CSCL 09/1

Schottky-barrier field-effect transistors with channel layers near 800 A thickness have been investigated. Investigations on palladium-silicon contacts have shown a barrier lowering exceeding the image-force lowering. Noise temperature measurements have been performed in the hot electron region to explain noise behavior of silicon Schottky-barrier FET's. The results indicate good agreement with the theory of Moll for low fields. GaAs Schottky-barrier FET's with high performance were realized in the one micron structure for gate length and contact separation. Device layout and technology are described in detail. A 17 GHz one-transistor oscillator with 4 mW output power and a four-stage amplifier operating at 14.9 GHz with a 3 dB bandwidth of 150MHz have been built with such GaAs transistors in a stripline technique. Author (GRA)

N72-12150# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering.
OPTIMUM CIRCUITS FOR GaAs OSCILLATORS: A THEORETICAL AND EXPERIMENTAL STUDY OF DEVICE-CIRCUIT INTERACTION AND MAXIMUM LIMITS OF OPERATION Final Phase Report
William Oliver Camp, Jr. Griffiss AFB, N. Y. Jun. 1971 230 p refs
(Contract F30602-68-C-0042; Job Order 55730000)
(AD-728269; RADC-TR-71-95) Avail: NTIS CSCL 09/5

The report is a study of the Limited Space-charge Accumulation (LSA) microwave oscillation using bulk GaAs material. The optimum circuit configuration and parameters were determined theoretically and verified experimentally. The theoretical study made extensive use of a time domain computer simulation that was found to be an accurate representation of the actual observation. In the course of the theoretical study, the device itself was analyzed and several simplifications in the concept of its operation were found to be true. This related to the use of a simple current versus voltage characteristic for a device that can have an unstable and complex internal electric field configuration. A further result of the simulation was to set a realistic upper limit on the dc to RF conversion efficiency of this oscillation mode. Experimental circuits were constructed for the purpose of viewing voltage and current waveforms for direct comparison with the computer generated data. This comparison and other data confirmed the predictions and implications of the theoretical study. That is, the GaAs device can in all but several special circumstances be described by a relatively simple current-voltage characteristic, that requires minimal previous history information. The circuit must satisfy special requirements at the fundamental and first three to five harmonics.

Author (GRA)

N72-12151# Syracuse Univ., N.Y. Dept. of Electrical Engineering.
ANTENNA OPTIMIZATION CRITERIA Final Report, 22 Sep. 1967 - 22 Mar. 1971
David K. Cheng Griffiss AFB, N. Y. RADC Apr. 1971 80 p refs
(Contract F30602-68-C-0067; ARPA Order 1010)
(AD-728270; RADC-TR-71-156) Avail: NTIS CSCL 09/5

The report is divided into two parts. Part (A) summarizes the essential optimization techniques for antenna arrays, including a method which makes only phase adjustments. Part (B) presents a new integral-equation approach for optimizing arrays with mutual coupling. This approach is particularly advantageous when an array contains many long dipole elements.

Author (GRA)

N72-12152# Harry Diamond Labs., Washington, D.C.
TRANSFERRED ELECTRON OSCILLATORS OPERATING IN THE TRANSIT TIME AND LIMITED SPACE CHARGE ACCUMULATION MODES Status Report
Abraham Singer Jun. 1971 28 p refs
(DA Proj. 1B2-62301-A-300; HDL Proj. 16100)
(AD-728104; HDL-TM-70-27) Avail: NTIS CSCL 09/1

The state of the art of transferred electron oscillators, particularly those operating in the limited space-charge accumulation (LSA) mode, is reviewed. The LSA mode is of particular interest because devices operating in this mode enjoy the very significant advantage of being immune to what constitutes a fundamental limitation of all other types of solid state oscillators: the power-impedance product. The power output of an LSA device is limited only by two factors: (1) the heat transfer efficiency of the heat sink, and (2) the microwave skin effect of the semiconductor. The first is not a function of the device itself, but rather of its environment. The second usually comes into play only at very high rfs (above the mm-wave range). Beyond X-band the theoretically predicted peak power limit for LSA operation is about six orders of magnitude above that for Gunn or avalanche operation. For example, at 10 Ghz, peak power outputs as high as 400 kW are predicted from a homogeneous piece of material about 1 cm in length.

Author (GRA)

N72-12153# Raytheon Co., Waltham, Mass. Special Microwave Devices Operation.
GALLIUM ARSENIDE MICROWAVE DIODES Final Report, 1 Jun. 1969 - 1 Jun. 1970
J. I. Hanoka Jul. 1971 45 p refs
(Contract DAAB07-69-C-0325; DA Proj. 1H6-62705-A-056)
(AD-728122; SM-231; ECOM-0325-F; Rept-0970-296) Avail: NTIS CSCL 09/1

Epitaxial Gallium Arsenide grown in a vapor phase, hydrogen, gallium, arsenic trichloride (H2-Ga-AsCl3) system has been produced in two separate reactors, each representing a different design approach. System No. 1 is a more conventional reactor with a bypass and stopcock controlled gas flow. Epi material has been reproducibly grown in this system. The resulting n on n& epi layers have been made into Schottky barrier avalanche transit time diodes, and then evaluated for microwave performance. System No. 2 employs some novel design approaches which should ultimately lead to high purity material. A third system using argon as a carrier gas was set up, but no growth could be obtained with it. It was concluded that oxygen present in the argon produced gallium oxide at the gallium boat and that this precluded successful growth.

Author (GRA)

N72-12652# Centre National d'Etudes Spatiales, Paris (France). Lab. de Technologie Optique.
MEASUREMENTS ON PHOTOMULTIPLIERS [MESURES SUR LES PHOTOMULTIPLICATEURS]
D. Husson *In its* 2nd Symp. on Optics 1969 p 187-194 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

N72-12653# Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
STUDY ON AN ELECTRON PHOTOMULTIPLIER TUBES WITHOUT WINDOW [ETUDE DU MULTIPLICATEUR TUBULAIRE D'ELECTRONS SANS FENETRE]
C. Barat *In* CNES 2nd Symp. on Optics 1969 p 195-211 refs In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

N72-12654# Direction des Recherches et Moyens d'Essais, Paris (France).
PRINCIPLES OF FUNCTIONING OF DIFFERENT IMAGE TUBES [LES PRINCIPES DE FONCTIONNEMENT DES DIFFERENTS TUBES A IMAGES]
Corfdir *In* CNES 2nd Symp. on Optics 1969 p 212-225 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

N72-12655# Centre National de la Recherche Scientifique, Verrieres-Le-Buisson (France). Service de Technologie Spatiale.
IMAGE CONVERTERS [LES CONVERTISSEURS D'IMAGE]
P. Balaskovic *In* CNES 2nd Symp. on Optics 1969 p 226-249 refs In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

N72-12170# Joint Publications Research Service, Washington, D.C.
RADIO COMPLEX, CONTROL SYSTEM AND SOURCE OF ELECTRIC CURRENT
V. P. Puchkov, L. L. Puchenko, F. I. Babkov, R. O. Belova, O.G. Ivanov, V. I. Malin, A. S. Makov, I. B. Merkov, Ye. G. Uzkiy, N. A. Zheleznov et al *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 28-40 (See N72-12168 03-11)
Avail: NTIS

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see 09 Electronic Equipment. For related information see specific Physics categories.

N72-12154# Technische Hogeschool, Eindhoven (Netherlands).
NON-ISOTHERMAL ANALYSIS OF CARRIER WAVES IN A SEMICONDUCTOR

Th. G. VandeRoer Aug. 1971 21 p refs
(TH-71-E-21; ISBN-90-6144-021-1) Avail: NTIS

Propagation of plane longitudinal carrier waves in a homogeneous isotropic extrinsic semiconductor is considered. Three transport equations for density, momentum and temperature are used with simple collision terms describing annihilation of momentum and transfer of energy from the carriers to the lattice in terms of momentum and energy relaxation times. These time constants are assumed to be temperature dependent to include effects of velocity saturation at high electric fields. The results are compared with the results of isothermal theory. Author

N72-12155*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE RELATIONSHIP BETWEEN PHASE STABILITY AND FREQUENCY STABILITY AND A METHOD OF CONVERTING BETWEEN THEM
Peter P. Bohn Oct. 1971 25 p refs Submitted for publication
(NASA-TM-X-65766; X-752-71-448) Avail: NTIS CSCL 09C

A method is presented for obtaining the value of the phase stability from time domain frequency stability measurements. Definition of frequency and phase stability are presented. The various types of noise sources in an oscillator and how their location in the oscillator circuitry determines the resultant phase and frequency noise spectrum are described. With this knowledge, the type of noise spectram from time domain frequency stability measurements is determined. Using certain conversions, the total phase noise spectrum is obtained, which is integrated to obtain the phase stability. Examples of the conversion process are also presented. Author

N72-12156# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
SCALER OF 100 MHz FOR PHYSICAL EXPERIMENTS
Z. Guzik, R. Krasovski, and M. Turala 1971 15 p refs In RUSSIAN
(JINR-P13-5793) Avail: AEC Depository Libraries

The scaler of 100 MHz is described for operating the schemes of nanosecond electronics. The scheme consists of six decades with indication and control arranged as one unit.
Author (NSA)

N72-12157# Institute of Nuclear Research, Warsaw (Poland).
CHARGE-SENSITIVE PREAMPLIFIERS WITH DYNAMIC LOAD RESISTANCE (BOOTSTRAP CONFIGURATION)
J. Wieckiewicz and J. Lenartowicz 1970 14 p refs In POLISH; ENGLISH summary
(INR-1241) Avail: AEC Depository Libraries

Calculations of dynamic load resistance and open loop gain are given. Optimization of dynamic load resistance is discussed and examples of working circuit diagrams are presented.
Author (NSA)

N72-12158# Iowa State Univ. of Science and Technology, Ames.
PERMUTATIONAL SYMMETRY IN ELECTRONIC SYSTEMS Ph.D. Thesis
William Irwin Salmon Jun. 1971 206 p refs
(Contract W-7405-eng-82)
(IS-T-468) Avail: NTIS

This work is concerned with the simplification of quantum-chemical calculations on electronic systems through the exploitation of permutational symmetry. Unrestricted configuration-interaction (CI) wave functions are constructed according to certain conventions which simplify the calculation of expectation values when S is a good quantum number. General wave functions are expressed in terms of pure-spin components of determinantal functions. These building blocks, called spin-adapted antisymmetrized products, or SAAP's, are designed to take advantage of double occupancy. It is shown that SAAP's, when constructed from orthonormal orbitals, can be handled in CI calculations more easily than Slater determinants. A computer program is given for the evaluation of coefficients occurring in the energy matrix elements. Two new methods are described for the construction of suitable spin eigenfunctions. Author

N72-12159# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
MULTI MICRO BEAMS FOR ION IMPLANTATION
G. Guernet and Ph. Glotin 26 Oct. 1970 10 p Presented at Conf. on Ion Implantation, Reading, Engl., 7-9 Sep. 1970
(CEA-CONF-1767; Conf-700945-2; LETI/ME-656) Avail: AEC Depository Libraries

Equipment for the fabrication of integrated circuits in a batch process using multi micro beams of charged particles is described. Several methods, commonly used, to produce ion implanted integrated circuits of given configurations are presented. The accelerator used in these experiments is described together with the way in which the microbeams are obtained. A double micro quadrupolar lens with filiform electrodes, the dimensions of which had been determined by computer simulation, was designed. A large number of spots (1000) of 1 micron diameter are obtained, the distance between two beams corresponding to the elementary cell length of the circuit (2 mm). The x y manipulation of the microscope is described. The applications of this new technique to the sensitization of the silicon dioxide and the metallic layer are discussed. Author (NSA)

N72-12160# Northwestern Univ., Evanston, Ill. Dept. of Electric Engineering.
ON APPLICATION OF GRAPH THEORY TO NETWORKS AND CODING THEORY Final Scientific Report
S. L. Hakimi 5 Aug. 1971 12 p refs
(AF Proj. 9749; Grant AF-AFOSR-0098-67)
(AD-728287; AFOSR-71-2205TR) Avail: NTIS CSCL 09/4

The report discusses work by the author and his co-workers in the following four major areas: (1) Communication Networks with particular emphasis in their vulnerability and survivability; (2) Graphy Theoretic Codes for transmission of information and their capabilities and the design of automatic error-correcting decoders for such codes; (3) Design and Analysis of Linear and Non-Linear Circuit with particular emphasis on the computer aided design; and (4) Topics in Applied Graph Theory such as, optimum job assignment and its generalizations and optimum location of warehouses in highway networks. Author (GRA)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N72-12161# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
FLAT PLATE BOUNDARY LAYER TRANSITION IN THE LUT GUN TUNNEL: A TRANSITION-RADIATED AERODYNAMIC NOISE CORRELATION FOR GUN TUNNEL AND CONVENTIONAL WIND TUNNEL DATA AT SUPERSONIC AND HYPERSONIC MACH NUMBERS
E. R. Bergstrom and S. Raghunathan Aug. 1971 34 p refs
(B/SR/8362)
(TT-7107) Avail: NTIS

Flat plate boundary layer transition data from the LUT gun tunnel and zero pressure gradient data from three other gun tunnels are analyzed, based on the Pate and Schueler aerodynamic noise correlation of conventional wind tunnel data, and are shown to be consistent with it. A wall to adiabatic wall temperature ratio effect is identified which is not explicit in the

original correlation of data for adiabatic surfaces. This is attributed to the wall cooling effect on boundary layer transition. A more fundamental correlation of wind tunnel and gun tunnel transition data is developed which involves the ratio free stream RMS acoustic pressure fluctuation to the stream static pressure level. This correlation is independent of the tunnel size and shows the effects of Mach number and unit Reynolds number. The Mach number effect is associated with the inherent boundary layer transition mechanism, and the unit Reynolds effect is interpreted as being a direct result of the associated change in the tunnel noise level. Author

N72-12162# Advisory Group for Aerospace Research and Development, Paris (France).
FACILITIES AND TECHNIQUES FOR AERODYNAMIC TESTING AT TRANSONIC SPEEDS AND HIGH REYNOLDS NUMBER
R. C. Pankhurst Oct. 1971 11 p refs
(AGARD-AR-37-71) Avail: NTIS

Scale effects on various flow phenomena and for various body shapes are discussed. Techniques are given for simulating the effects of higher Reynolds numbers. The requirements and types of experimental facilities which can achieve high Reynolds numbers at transonic speeds are considered. Author

N72-12163# Lockheed Missiles and Space Co., Palo Alto, Calif.
LIMITING FIRING RANGE
A. A. Lebedev and N. F. Gerasiuta [1971] 25 p Transl. into English from the book "Ballistika Raket" Moscow, Mashinostroenie, 1970 p 214-241
Avail: NTIS; National Translation Center, John Crerar Library, Chicago, Ill. 60616

Constraints on ballistic missile firing range are examined, especially those due to the possibility of a shortage of propellant components. The nominal trajectory and fundamental structural parameters of the missile were previously chosen to assume the greatest possible firing range. Calculation of guaranteed propellant reserves is discussed, and equations of motion of the missile's center of mass are presented. The influence of small perturbing factors on maximum range is considered for missiles with and without a system of apparent velocity regulation. The distribution of guaranteed reserves between missile stages and the dimuinution of reserves by regulating the consumption of propellant components are evaluated. Methods for determining load and the demands it imposes are also presented. The requisite capacities of the propellant systems are described, and load determinations for given capacities are considered. Author

N72-12164*# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.
THE INTERACTION OF O(PLUS) IONS WITH THE INTERIOR SURFACE OF A COPPER CHAMBER Final Report
M. W. Siegel and J. W. Boring Sep. 1971 19 p refs
(Grant NGR-44-005-077)
(NASA-CR-122299; AEEP-4011-105-71U) Avail: NTIS CSCL 14B

Modulated beams of O(+), Ar(+), and Kr(+) in the 100-300 eV range are directed into a copper box simulating the ante-chamber of an orbiting mass spectrometer. An RF quadrupole mass spectrometer and phase sensitive detection extract the component of the internal mass spectrum correlated with the beam. Intense Ar and Kr signals are observed; however, no O or O2 is detectable, indicating loss of the primary O(+) beam to surface interactions. All four primary ions stimulate sizeable signals at masses 26 and 28. The relevance of these experiments to the interpretation of mass spectra obtained by orbiting satellites is discussed. Author

N72-12165*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MOBILITY SYSTEMS ACTIVITY FOR LUNAR ROVERS AT MSFC
Clyde S. Jones, Jr. and Frank J. Nola 9 Sep. 1971 41 p refs
(NASA-TM-X-64623) Avail: NTIS CSCL 13F

The Apollo Lunar Roving Vehicle (LRV) mobility system is described. Special emphasis is given to the redundancy aspects and to the selection of the drive motors. A summary chart of the performance on the lunar surface during the Apollo 15 flight is included. An appendix gives details on some development work on high efficiency drive systems and compares these systems to the selected system. Author

N72-12166*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATUS OF POWER GENERATION EXPERIMENTS IN THE NASA LEWIS CLOSED CYCLE MHD FACILITY
Ronald J. Sovie and Lester D. Nichols [1971] 10 p refs Presented at the 10th Aerospace Sci. Meeting, San Diego, 17-19 Jan. 1972; sponsored by AIAA
(NASA-TM-X-67975) Avail: NTIS CSCL 14B

The design and operation of the closed cycle MHD facility is discussed and results obtained in recent experiments are presented. The main components of the facility are a compressor, recuperative heat exchanger, heater, nozzle, MHD channel with 28 pairs of thoriated tungsten electrodes, cesium condenser, and an argon cooler. The facility has been operated at temperatures up to 2100 K with a cesium-seeded argon working fluid. At low magnetic field strengths, the open circuit voltage, Hall voltage and short circuit current obtained are 90, 69, and 47 percent of the theoretical equilibrium values, respectively. Comparison of this data with a wall and boundary layer leakage theory indicates that the generator has shorting paths in the Hall direction.
Author

N72-12167# Joint Publications Research Service, Washington, D.C.
MEASURING AND MONITORING THE SPATIAL CHARACTERISTICS OF EXTERNAL BEAMS OF THE YEREVAN RING ELECTRON ACCELERATOR
G. A. Arakelyan, G. S. Vartanyan, S. K. Yesin, I. I. Karabekov, A. M. Kotsinyan, M. A. Martirosyan, and Yu. R. Nazaryan 12 Nov. 1971 6 p Transl. into ENGLISH from Pribory Tekhn. Eksperim. (Moscow), no. 4, 1971 p 46-48
(JPRS-54479; UDC-621.3.032.266; CSO-0634/72-S) Avail: NTIS

The apparatus and methods are described for determining: the current of accelerated particles which deflect on the internal target; the vertical electron beam position at the instant of deflection, and at the point of deflection; and the position of the gamma beam's center of gravity. Methods for using the information obtained for regulating the accelerator parameters in the ejection stage are discussed. Author

N72-12168# Joint Publications Research Service, Washington, D.C.
LUNOKHOD-1: MOBILE LUNAR LABORATORY
A. P. Vinogradov, ed. 22 Nov. 1971 192 p refs Transl. into ENGLISH of the book "Peredvizhnaya Laboratoriya na Lune Lunokhod-1" Moscow, Nauka, 4 Jun. 1971 p 1-128
(JPRS-54525) Avail: NTIS

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8. STUDY OF LOCAL TERRAIN ALONG THE LUNOKHOD-1 TRAJECTORY B. N. Rodionov, B. V. Nepoklonov, and V. V. Kiselev p 97-112 refs (See N72-12174 03-30)

9. DETERMINING GEOMETRIC DIMENSIONS AND DISTRIBUTION OF CRATERS TRAVERSED BY LUNOKHOD-1 ON LUNAR SURFACE B. I. Garin, A. K. Leonovich, F. P. Pavlov, V. B. Georgiyev, and P. S. Semenov p 113-119 (See N72-12175 03-30)

10. STUDIES OF LUNAR GROUND MECHANICAL PROPERTIES WITH THE SELF-PROPELLED LUNOKHOD-1 A. K. Leonovich, V. V. Gromov, A. V. Rybakov, V. K. Petrov, P. S. Pavlov, I. I. Cherkasov, and V. V. Shvarev p 120-135 (See N72-12176 03-30)

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12. PRELIMINARY RESULTS OF GEOMORPHOLOGICAL STUDY OF PANORAMAS K. P. Florenskiy, A. T. Bazilevskiy, A. A. Pronin, and Z. V. Popova p 147-174 refs (See N72-12178 03-30)

13. COSMIC RAY RESEARCH S. N. Vernov, G. P. Lyubimov, Ye. A. Chuchkov, and N. N. Kontor p 175-189 refs (See N72-12179 03-29)

N72-12169# Joint Publications Research Service, Washington, D.C.

GENERAL DESIGN AND CONSTRUCTION OF LUNA-17 STATION

K. S. Anisov, V. I. Mastakov, O. G. Ivanov, L. N. Leonidov, G. N. Nikolayev, A. D. Dneprov, A. K. Aleksandrov, P. S. Semenov, A. F. Grachev, V. I. Komarov et al *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 4-27 (See N72-12168 03-11)
Avail: NTIS

The Luna-17 automatic station consisted of two main parts: a unified landing state and an automatic self-propelled vehicle. The unified landing stage was an independent rocket unit designed for making flight trajectory corrections on the earth-moon path, putting the station into a lunar orbit, and implementing a prelanding circumlunar orbit and a soft landing on the lunar surface. The unified landing stage included a correcting-braking engine with a fuel system, two compartments which could be jettisoned, instrument compartments, and a landing apparatus. The lunokhod was a self-propelled vehicle automatically controlled from the earth. It consisted of two main parts: a pressurized instrument compartment containing measuring devices and a self-propelled chassis. The instrument compartment held the instrumentation of the lunokhod on-board systems and protected it from the ambient conditions in space. The instrument compartment and its contents were mounted on an eight-wheeled self-propelled chassis. The lunokhod weighed 756 kg. A.L.

N72-12170# Joint Publications Research Service, Washington, D.C.

RADIO COMPLEX, CONTROL SYSTEM AND SOURCE OF ELECTRIC CURRENT **c09**

V. P. Puchkov, L. L. Puchenko, F. I. Babkov, R. O. Belova, O. G. Ivanov, V. I. Malin, A. S. Makov, I. B. Merkov, Ye. G. Uzkiy, N. A. Zheleznov et al *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 28-40 (See N72-12168 03-11)
Avail: NTIS

The principal in-flight missions performed by the control system were: (1) maintenance of a stipulated position of the last stage of the carrier rocket with the station during flight in circumterrestrial orbit; (2) spatial control of station position in flight to moon, during lunar orbit, and during landing on lunar surface; (3) stabilizing the station during operation of the landing stage engine in a fixed position; and (4) regulating landing stage engine thrust deceleration during the course of landing on the lunar surface. The control system consisted of gyroscopic instruments, computers, engine control units, commutating units, and actuating components. The radio complex was designed for solving the problem of ensuring flight to the moon, landing, and operating the lunokhod on the lunar surface. The radio complex consisted of: radio communication systems, time-programming devices, telephoto-panoramic and television cameras. The principal source of electric current was a solar cell consisting of a large number of photoconverters connected in a series-parallel system. The choice of photoconverters and design innovation ensured faultless operation of the cell over a wide temperature range. A.L.

N72-12171# Joint Publications Research Service, Washington, D.C.

THERMAL REGIME AND HEAT REGULATING SYSTEM **c33**

I. A. Yelenov, A. M. Rybin, and A. S. Yakovlev *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 41-46 (See N72-12168 03-11)
Avail: NTIS

The required thermal regime was created by a heat regulating system which maintained the gas temperature in the instrument compartments and the temperature of the construction components and equipment located within the pressurized compartments and outside them within stipulated limits. The heat regulating system for the Luna-17 station consisted of two independent autonomous systems: a system for lunokhod heat regulation and a system for heat regulation of the landing stage. To reduce the heat loss virtually the entire outer surface of the station was covered by multilayer shielding-vacuum heat insulation. Parts of the station surface and construction components not covered by the shielding-vacuum insulation had heat regulating coatings to maintain temperatures within specified ranges. For circulating gas in the instrument compartments within the landing stage and carrying off the heat excess from thermally stressed instrument compartments the station had fans which were automatically activated during communication contacts. The engine thermal regime was controlled by means of a special cover which opened prior to firing and which closed after the main engine jet had fired. A.L.

N72-12172# Joint Publications Research Service, Washington, D.C.

CONTROL AND RESULTS OF PROGRAM IMPLEMENTATION **c07**

A. A. Aleksandrov, P. A. Artemyev, G. I. Bofatov, I. A. Yelenov, O. G. Ivanov, V. A. Ryvkina, Ye. G. Uzkiy, A. I. Shakhov, F. P. Pavlov, Yu. P. Kotlov et al *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 47-74 (See N72-12168 03-11)
Avail: NTIS

Flight control for the Luna-17 station with the Lunokhod-1 aboard and then control over the Lunokhod-1 automatic self-controlled vehicle included the following stages: (1) launching and injection into an intermediate earth orbit; (2) flight along the earth-moon trajectory; (3) injection into a circumlunar orbit and maneuvering in an artificial lunar satellite orbit; (4) landing in the selected region on the moon, preparations for descent, and descent of the lunokhod from the landing stage; and (5) control of the lunokhod on the lunar surface. The lunokhod remote control system was designed to ensure safe movement along the lunar surface in the stipulated direction with the maximum mean velocity. The system was classified as a saturated closed automatic control system. Ground and onboard radio equipment

was used in the remote control of the vehicle. This equipment ensured the transmission and reception of control radio commands, telemetric information, and television images. The vehicle was remotely controlled by a group of operators called the lunokhod crew. A.L.

N72-12173# Joint Publications Research Service, Washington, D.C.

DESIGN CHARACTERISTICS AND PRINCIPAL PARAMETERS OF LUNOKHOD-1 TELEVISION SYSTEMS c07

A. S. Selivanov, V. M. Govorov, V. V. Zasetskiy, and V. A. Timokhin *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 75-96 refs (See N72-12168 03-11)

Avail: NTIS

Creation of the mobile scientific laboratory Lunokhod-1 required improvement of all radio engineering systems used in space research, including the television equipment which performed a number of important functions on the vehicle. The television equipment formed a single complex for use in solving the following fundamental problems: (1) control of lunokhod movement; (2) studying the geological-morphological and topographic characteristics of the lunar surface; and (3) observations of the earth and sun for navigation purposes. The operating principle and principal parameters of the television systems were selected in accordance with these objectives and the specific conditions for operation of instruments aboard the self-propelled vehicle. A television complex consisting of two image transmission systems substantially differing in their functions and working parameters was designed. The system consisted of: (1) a panoramic television system for investigating the structure of the lunar surface, carrying out topographic surveys, and celestial observation; and (2) an electronic slow-frame system for monitoring movement of the vehicle. A.L.

N72-12174# Joint Publications Research Service, Washington, D.C.

STUDY OF LOCAL TERRAIN ALONG THE LUNOKHOD-1 TRAJECTORY c30

B. N. Rodionov, B. V. Nepoklonov, and V. V. Kiselev *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 97-112 refs (See N72-12168 03-11)

Avail: NTIS

The reconnaissance survey of the lunar surface from the Lunokhod-1 required the solution of a number of new methodological problems. In particular, a method was developed for using navigation information on movement of the self-propelled vehicle for a reconnaissance survey, as well as a method for photogrammetric interpretation of the photographs taken with the course cameras and a method of azimuthal orientation based on astropanoramas. The processing of survey information received from the vehicle and its topographic interpretation were performed by an integrated team of specialists in the fields of space geodesy and photogrammetry. In addition to the strictly topographic work done in compiling the profile, diagram, and plans, the television images were routinely processed photogrammetrically by the lunokhod crew. This involved evaluating the topographic situation, primarily obstacles such as rocks and craters, for selecting the best direction of lunokhod movement. A.L.

N72-12175# Joint Publications Research Service, Washington, D.C.

DETERMINING GEOMETRIC DIMENSIONS AND DISTRIBUTION OF CRATERS TRAVERSED BY LUNOKHOD-1 ON LUNAR SURFACE c30

B. I. Garin, A. K. Leonovich, F. P. Pavlov, V. B. Georgiyev, and P. S. Semenov *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 113-119 (See N72-12168 03-11)

Avail: NTIS

A method was developed for determining the dimensions of craters on the lunar surface traversed by the lunokhod on the basis of telemetric information from the sensors registering the lunokhod path, banking, and fore-to-aft listing. The method has two modifications, geometric and analytic. The latter method makes it possible to solve the problem of determining the parameters of lunar craters with a digital computer and to ascertain the characteristics of lunar relief in tempo with lunokhod movement. Over a period of five lunar days the lunokhod traversed more than 140 craters along a total path of 7.3 km. Some of these craters were registered on lunar surface photopanoramas. The discrepancy in the size of craters determined in this way and from interpretation of the panoramas did not exceed 10-12 percent. A.L.

N72-12176# Joint Publications Research Service, Washington, D.C.

STUDIES OF LUNAR GROUND MECHANICAL PROPERTIES WITH THE SELF-PROPELLED LUNOKHOD-1 c30

A. K. Leonovich, V. V. Gromov, A. V. Rybakov, V. K. Petrov, P. S. Pavlov, I. I. Cherkasov, and V. V. Shvarev *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 120-135 (See N72-12168 03-11)

Avail: NTIS

Experiments for investigating the mechanical properties of the lunar surface provided for determinations of its strength and deformational properties under natural conditions along the entire path of movement of the lunokhod. Ground investigations were made by several methods: (1) A special instrument was used to introduce and rotate a conical-bladed punch into the ground to determine the indices of ground carrying capacity, its compactability, and resistance to rotational shear. (2) During lunokhod movement, continous measurements were made of the parameters of interaction between the undercarriage of the vehicle and the ground. (3) Investigation from the photopanoramas of the nature of ground destruction under the influence of the lunokhod wheels. During three months of operation there were 327 measurements of mechanical properties made in different surface sectors, including craters, concentrations of rocks, individual rocks, horizontal and sloping surface sectors. A.L.

N72-12177# Joint Publications Research Service, Washington, D.C.

THE RIFMA LUNAR AUTOMATIC SPECTROMETRIC APPARATUS c30

G. Ye. Kocharov, N. F. Borodulin, S. V. Viktorov, O. M. Voropayev, A. Yu. Dzevanovskaya, O. G. Ivanov, G. V. Kiryan, V. V. Petrov, and V. A. Sakulskiy *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 136-146 refs (See N72-12168 03-11)

Avail: NTIS

Chemical analysis of the lunar surface was accomplished by use of X-ray spectrometric instruments carried aboard the lunokhod. The RIFMA apparatus contained radioactive sources for irradiating the lunar surface, detectors for registering ground X-radiation, and electronic devices. The onboard equipment consisted of three units: an extensible unit situated outside the lunokhod instrument compartment; an electronic unit; and a pulse digital converter. The RIFMA equipment successfully withstood launching, lunar landing, and the complex conditions involved in the lunar experiment. Over the course of several lunar days this apparatus ensured contactless speedy analysis of the chemical composition of the lunar surface along the lunokhod trajectory in the Mare Imbrium. A.L.

N72-12178# Joint Publications Research Service, Washington, D.C.

PRELIMINARY RESULTS OF GEOMORPHOLOGICAL STUDY OF PANORAMAS c30

K. P. Florenskiy, A. T. Bazilevskiy, A. A. Pronin, and Z. V. Popova *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 147-174 refs (See N72-12168 03-11)

Avail: NTIS

Preliminary data are given on the geology and geomorphology of the Mare Imbrium region based primarily on the results of studies of panoramas obtained during the first three days of the lunokhod operation. Conclusions reached were: (1) The landing site and area of operation of Lunokhod-1 constitute a slightly undulating plane whose surface is complicated by cuplike craters

of varying distinctness. (2) Among craters from 5-10 cm to 30-40 m in diameter there is a predominance of mature and destroyed morphological class B and C craters. (3) Rocks with a diameter of several centimeters and tens of centimeters are associated primarily with fresh craters. (4) The rocks in ejecta from fresh craters are extremely variable in configuration. (5) Rocks with a rounded configuration are encountered for the most part near mature craters. (6) The regolith covering the bedrock surface is poorly bound material and the thickness in the studied region varied greatly. (7) Surface evolution occurs primarily under the influence of two factors: formation of impact-explosive and impact craters with sharp, clearly defined forms; and destruction of craters forming at different times, accompanied by surface erosion and rock destruction. A.L.

N72-12179# Joint Publications Research Service, Washington, D.C.
COSMIC RAY RESEARCH **c29**
S. N. Vernov, G. P. Lyubimov, Ye. A. Chuchkov, and N. N. Kontor *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 175-189 refs (See N72-12168 03-11)
Avail: NTIS

The Lunokhod-1 carried instrumentation designed for investigating low energy cosmic rays and also for monitoring the level of solar proton activity during flight of the Luna-17 station from the earth to the moon and during lunokhod operation on the lunar surface. Described are: design of the instrumentation and its measuring characteristics, the scientific and methodological problems to be solved in the experiment, and the preliminary results of measurements of protons with an energy of 1-5 MeV. A.L.

N72-12180*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE GEORGE C. MARSHALL SPACE FLIGHT CENTER'S 14 BY 14 INCH TRISONIC WIND TUNNEL TECHNICAL HANDBOOK
Erwin Simon 5 Nov. 1971 46 p refs
(NASA-TM-X-64624) Avail: NTIS CSCL 14B

A handbook, containing a description of the 14 x 14 inch trisonic wind tunnel facility, is presented. The data is designed for the potential user of the facility who is not otherwise familiar with its operation. The following items are presented to illustrate the capabilities and operation of the tunnel: (1) facility description, (2) performance and operational characteristics, (3) model design, (4) instrumentation and data recording equipment, (5) data processing and presentation, and (6) preliminary test information required. Author

N72-12181*# TRW Systems Group, Redondo Beach, Calif.
OPERATING MANUAL: FAST RESPONSE SOLAR ARRAY SIMULATOR
R. VonHatten, A. Weimer, and D. Zerbel 21 Oct. 1971 169 p
(Contract NAS5-11581)
(NASA-CR-122308) Avail: NTIS CSCL 14B

The fast response solar array simulator (FRSAS) is a universal solar array simulator which features an AC response identical to that of a real array over a large range of DC operating points. In addition, short circuit current (I sub sc) and open circuit voltage (V sub oc) are digitally programmable over a wide range for use not only in simulating a wide range of array sizes, but also to simulate (I sub sc) and (V sub oc) variations with illumination and temperature. A means for simulation of current variations due to spinning is available. Provisions for remote control and monitoring, automatic failure sensing and warning, and a load simulator are also included. Author

N72-12182*# McDonnell Aircraft Corp., St. Louis, Mo.
AN INVENTORY OF AERONAUTICAL GROUND RESEARCH FACILITIES. VOLUME 1: WIND TUNNELS
C. J. Pirrello, R. D. Hardin, M. V. Heckart, and K. R. Brown Washington NASA Nov. 1971 314 p
(Contract NAS2-5458)
(NASA-CR-1874) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

A survey of wind tunnel research facilities in the United States is presented. The inventory includes all subsonic, transonic, and hypersonic wind tunnels operated by governmental and private organizations. Each wind tunnel is described with respect to size, mechanical operation, construction, testing capabilities, and operating costs. Facility performance data are presented in charts and tables. Author

N72-12183*# McDonnell Aircraft Corp., St. Louis, Mo.
AN INVENTORY OF AERONAUTICAL GROUND RESEARCH FACILITIES. VOLUME 3: STRUCTURAL
C. J. Pirrello, R. D. Hardin, M. V. Heckart, and K. R. Brown Washington NASA Nov. 1971 271 p
(Contract NAS2-5458)
(NASA-CR-1876) Avail: NTIS CSCL 14B

An inventory of test facilities for conducting acceleration, environmental, impact, structural shock, load, heat, vibration, and noise tests is presented. The facility is identified with a description of the equipment, the testing capabilities, and cost of operation. Performance data for the facility are presented in charts and tables. Author

N72-12184# Scientific Research Inst. of Electro-Physical Apparatus, Leningrad (USSR).
PRESSURE VARIATION SYSTEM OF A 4.5 METER BUBBLE CHAMBER
A. V. Astakhov, V. A. Bolshakov, G. A. Grad, A. V. Popkovich, E. P. Kuznetsov, M. A. Samarin, and V. I. Snyatkov 1970 14 p refs In RUSSIAN; ENGLISH summary
(NP-18930) Avail: AEC Depository Libraries

The construction and operation principle of the pneumatic pressure variation system of the 4.5-m bubble chamber are presented. This system provides the means to decrease the pressure of the chamber expansion volume from 30 up to 8 atm within approximately 60 msec and to increase it from 8 up to 30 atm within approximately 40 msec. The system for restoring the reference pressures in receivers after each expansion cycle is considered. Author (NSA)

N72-12185# Tokyo Univ. (Japan). Inst. for Nuclear Study.
HORIZONTAL AIR SHOWER TRIGGER SYSTEM BY FAST TIMING METHOD
Takano Motonobu Jul. 1970 18 p refs In JAPANESE
(INS-TCA-28) Avail: AEC Depository Libraries

The frequency of horizontal air showers is less than 1/5000 of that of vertical air showers. Consequently, the method to trigger when a fixed number of particles enter a detector is not efficient for the pickup of horizontal air showers. A system intended to antigate vertical air showers based on the principle that the particles of vertical air showers reach horizontally located detectors at the same time is described. Five fast timing detectors were placed in a pyramid-shape, four at the bottom corners and one at the apex. Each fast timing detector at the four corners was connected to its respective pulse shaper. The four outputs from the four pulse shapers (25ns pulse) were added in the vertical shower coincidence circuit. Vertical air showers generate simultaneous pulses in the four outputs, and make the added pulse height high. The trigger pulse for data recording is stopped by an antigating method when coming shower is recognized to be a vertical shower. Results are presented and discussed. NSA

N72-12186# Princeton-Pennsylvania Accelerator, Princeton, N.J.
SURVEY OF EXPERIMENTS RUN AT THE PRINCETON-PENNSYLVANIA ACCELERATOR, 1963-1971
15 Jun. 1971 51 p refs
(Contract AT(30-1)-2137)
(PPAR-24) Avail: NTIS

Brief summaries are given of the research performed at the Princeton-Pennsylvania Accelerator during the period of its operation from 1963 to 1971. A graphical display of the research program and a list of Ph.D. theses prepared from this research are also included. NSA

N72-12187# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

SAFETY SYSTEMS FOR AVOIDING IRRADIATION ACCIDENTS AROUND ACCELERATORS

H. Vialettes 1971 19 p refs In FRENCH Presented at Intern. Congr. on Protection Against Accelerator and Space Radiation, Geneva, 26-30 Apr. 1971

(CEA-CONF-1765; Conf-710423-2) Avail: AEC Depository Libraries

Various typical accidents due to the absence of safety devices, their insufficiency, or defective operation are described, and the measures to be adopted to prevent such accidents in the future are enumerated including evacuation of personnel from the danger area, locking of the doors, radiation monitoring, indication of the state of operation of the accelerator, and the possibilities of access and irradiation level in the working area. The safety devices connected with the linear accelerator at Saclay are described. NSA

N72-12188# European Organization for Nuclear Research, Geneva (Switzerland).

MEASUREMENTS AND CORRECTION OF THE MAGNETIC FIELD OF THE 1 GeV SYNCHROCYCLOTRON OF THE A. F. IOFFE PHYSICO-TECHNICAL INSTITUTE (ORDER OF LENIN). PART 1: SHAPING THE RADIAL FALL-OFF AND CORRECTING AZIMUTHAL NON-UNIFORMITIES

N. K. Abrosimov, V. A. Eliseev, I. A. Petrov, G. A. Ryabov, and I. I. Tkach Mar. 1971 17 p refs Transl. into ENGLISH of Russian report FTI-129

(CERN-Trans-71-7; FTI-129) Avail: AEC Depository Libraries

Requirements are formulated in respect of the magnet field of the synchrocyclotron of the P.T.I (Order of Lenin) of the USSR Academy of Sciences. A description is given of the technique used for shaping in the fall-off and correcting azimuthal non-uniformities in the magnetic field. The main features of the field produced are: improved focusing in the central region; a slow variation in the fall-off index, free from sharp local jumps; and an amplitude of the first field harmonic $<$ or $=$ 0.0001. Author (NSA)

N72-12189# Bhabha Atomic Research Centre, Bombay (India). Nuclear Physics Div.

VAN DE GRAFF LABORATORY PROGRESS REPORT Progress Report, 1 Jan. - 31 Dec. 1970

T. P. David, comp. 1971 54 p refs

(BARC-543) Avail: AEC Depository Libraries

The development and operation of the 5.5-MeV Van de Graaff accelerator at Trombay are discussed. Nuclear research experiments are outlined, and instrumentation development is described. NSA

N72-12190# European Organization for Nuclear Research, Geneva (Switzerland).

MEASUREMENT AND CORRECTION OF THE MAGNETIC FIELD OF THE A. F. IOFFE PHYSICO-TECHNICAL INSTITUTE (ORDER OF LENIN) 1 GeV SYNCHRO-CYCLOTRON. PART 2: CORRECTING THE POSITION OF THE MEDIAN SURFACE

N. K. Abrosimov, V. A. Eliseev, I. A. Petrov, and G. A. Ryabov Mar. 1971 11 p refs Transl. into ENGLISH of Russian report FTI-130

(CERN-Trans-71-15; FTI-130) Avail: AEC Depository Libraries

The synchrocyclotron's field parameters, which must be checked in order to restrict the axial motion of the accelerated particles, are discussed. An examination is made of the effect of the non-horizontal positioning of the PTI magnet's pole pieces on the values of the radial field component when measured with a vertically-oriented Hall detector. A procedure is described for correcting the position of the median surface. As a result of the work done, the deviation of the orbital plane of the particles from the mean geometrical plane due to the magnetic field does not exceed 1 cm, while distortion of the orbital plane is negligible. Author (NSA)

N72-12191# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Energii.

SYSTEM OF SLOW TARGETING OF ACCELERATED BEAM ON THE INTERNAL TARGETS OF 70 GeV ACCELERATOR

V. I. Gridasov, A. A. Kardash, K. M. Kozlov, O. V. Kurnaev, V. V. Lapin, S. V. Lobanov, L. L. Moizhes, K. P. Myznikov, and A. A. Naumov 1970 18 p refs In RUSSIAN

(IFVE-SKU-70-57) Avail: AEC Depository Libraries

Principles and detailed description of the internal target system used at the IHEP accelerator are given. The system is for the generation of secondary particle beams with duration of more than 1 sec. The method of an artificial excitation of the magnetic field local inhomogeneity in the accelerator units is used. This method radially extends an operational range of the targets. A density homogeneity of the ejected beams and supression of the time structure are achieved by means of a particle current feedback in the excitation system of the magnetic field asymmetry and by a wide frequency range of the power supply source. Author (NSA)

N72-12192# California Univ., Berkeley. Lawrence Radiation Lab.

COLLECTIVE LINEAR ACCELERATION OF IONS AND CLASSICAL PRINCIPLES OF ACCELERATION

Ivan Enchevich Apr. 1971 27 p refs Transl. into ENGLISH from Fiz. Mat. Spisanie, Bulgar. Akad. Nauk. (Sofia), v. 12, 1969 p 22-27

(UCRL-Trans-1447) Avail: NTIS

A brief history of the development and principles of operation of particle accelerators is given, and the theory of operation of electron-ring accelerators is described. The status of electron-ring accelerator development is outlined. NSA

N72-12193# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Lab. Nazionali di Frascati.

THE SACLAY'S HIGH DUTY CYCLE LINAC: PERFORMANCES OF THE MACHINE, EXPERIMENTAL FACILITIES, AND FIRST EXPERIMENTS

C. Schuhl Dec. 1970 14 p refs Presented at the Meeting on Electronsynchrotron, Frascati, Italy, 5-7 Nov. 1970

(LNF-70/62; Conf-701121-6) Avail: AEC Depository Libraries

The internal target for positron conversion is described, and beam parameter data are given. Also, the beam handling system and the experimental areas are described. NSA

N72-12194# Rutherford High Energy Lab., Chilton (England).

A PION BEAM FOR RADIOBIOLOGICAL AND DOSIMETRIC STUDIES, USING A PROTON SYNCHROTRON EXTERNAL TARGET

D. R. Perry and M. A. Hynes [1971] 9 p refs Presented at the Intern. Congr. on Protection against Accelerator and Space Radiation, Geneva, 26-30 Apr. 1971

(RPP/R-8; CONF-710423-6) Avail: AEC Depository Libraries

A beam line with stopping negative pions was constructed adjacent to one of the extracted proton beam targets of a 7-GeV proton synchrotron. The beam line transports particles of either sign with any required momentum up to 200 MeV/c. Pion beams are available for any tissue-equivalent range up to 30 cm. The beam line must operate at 94 deg to the extracted beam in order to share a target with secondary beams of higher momentum operating at the same time. The solutions of the beam transport problems resulting from this arrangement are discussed. The beam line is designed to concentrate particles, within a selected momentum band, with reasonable uniformity

over a 2-cm diameter area. Preliminary tests of the beam confirm its suitability for radiobiological experiments at dose rates up to 20 rads per hour. Author (NSA)

N72-12195# Danish Atomic Energy Commission, Risoe.
HIGH POWER MICROWAVE WATER LOAD FOR THE RISOE 10-MeV LINEAR ACCELERATOR [HOEJEFFEKT MIKROBOELGEBELASTNING TIL RISOES 10 MEV LINEAERE ACCELERATOR]
Johnny Hansen Jun. 1971 20 p refs In DANISH; ENGLISH Summary
(RISO-M-1386) Avail: AEC Depository Libraries

For absorption of the remaining power from the accelerator microwave system, a load was constructed with water as the absorbing medium. The water load consisted of a chamber filled with water separated from the rectangular waveguide transmission system by a ceramic window. The matching of the impedance of the water chamber to the waveguide impedance was performed by means of a single post obstacle within the waveguide. The water load was constructed for an average power of 3 kW and a peak power of 1.25 MW, with a maximum voltage standing wave ratio of 1.2. Author (NSA)

N72-12196# United Kingdom Atomic Energy Authority, Harwell (England). Nuclear Physics Div.
NOTE ON THE ENERGY SPREAD VERSUS RADIAL OSCILLATION AMPLITUDE FOR THE SYNCHROCYCLOTRON REGENERATIVE BEAM EXTRACTOR
D. West May 1971 8 p refs
(AERE-R-6812; HL71/2709(C.19)) Avail: AEC Depository Libraries; UK 9 p

The magnetic field surveys taken during the installation of the extractor are used, in conjunction with orbit tracking computer programs to derive the relation between the amplitude of radial oscillations and energy spread in the extracted beam. Author (NSA)

N72-12197# United Kingdom Atomic Energy Authority, Harwell (England).
EQUIPMENT FOR STUDYING THE LONG-TERM STABILITY OF STRUCTURAL MATERIALS UNDER IRRADIATION
N. P. Losev, B. V. Samsonov, and V. A. Tsykanov May 1970 15 p Transl. into ENGLISH from Russian report Presented at Joint UK/USSR Seminar on the Operation and Use of Res. and Testing Reactors, Harwell, Engl., Oct. - Nov. 1969
(LB/G-3012; Conf-691060-12) Avail: AEC Depository Libraries

Apparatus for long-term strength testing of samples of stainless steel tubes by internal gas pressure during irradiation in a reactor hole is described. Samples are heated by absorption of gamma radiation energy and the gas pressure inside the samples is automatically controlled. Author (NSA)

N72-12198# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
FLOW UNSTEADINESS AND MODEL VIBRATION IN WIND TUNNELS AT SUBSONIC AND TRANSONIC SPEEDS
D. G. Mabey London Aeron. Res. Council 1971 101 p refs Supersedes RAE-TR-70184; ARC-32716
(ARC-CP-1155; RAE-TR-70184; ARC-32716) Avail: NTIS; HMSO: £1.30; BIS: $4.95

Flow unsteadiness and model vibration in the 3 ft x 3 ft tunnel have impeded static and dynamic measurements at subsonic and transonic speeds. The unsteadiness was measured with pressure transducers both in the 3 ft x 3 ft tunnel and a 1/9 scale model of this tunnel, and good agreement was obtained. For the closed 3 ft x 3 ft tunnel, successive modifications to the balance section and diffuser derived from tests of the model have reduced the unsteadiness at subsonic speeds to an acceptable level for dynamic tests. The unsteadiness in the slotted tunnels operated by diffuser suction originated in the extraction region was reduced in the tunnel by covering the slots with perforated screens. The perforated and closed working sections of the model tunnel had nearly the same unsteadiness, and a similar result was achieved with the perforated working for the 3 ft x 3 ft tunnel in the frequency range of 20 to 900 Hz. Edge-tones generated at low unit Reynolds number were eliminated by a modification to the hole geometry. Author (ESRO)

N72-12199# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
TRIAL TESTS OF THE LOW SPEED WIND TUNNEL CO 1 [PREMIERS ESSAIS DE FONCTIONNEMENT DE LA SOUFFLERIE CO 1 A BASSE VITESSE]
F. Kauba 15 Jun. 1971 18 p In FRENCH
(LRBA-1-031-NT-1/SAE) Avail: NTIS

The correlation between tests carried out with a full-scale low speed wind tunnel (65 m/s) and tests made with a wind tunnel model are described. The tests were made prior to and during the reconstruction of the wind tunnel, after relocation, with the object of achieving more flexible operation. Certain automatic control gear was not operational at the time of full-scale testing. The measurement of exhaust flow using a Prandtl sensor is described, and the correlation of full-scale models is discussed for measurements of roll, lift, and pitching moment. ESRO

N72-12200# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THE MK 2 UTIAS IMPLOSION DRIVEN HYPERVELOCITY LAUNCHER DESIGN ANALYSIS Interim Scientific Report
V. C. D. Dawson, R. A. Waser, and D. O. Oakes Wright-Patterson AFB, Ohio ARL Feb. 1971 39 p refs Supersedes AD-707111
(Contract AF 33(615)-5313; AF Proj. 7065)
(AD-725807; AD-707111; UTIAS-TN-147) Avail: NTIS CSCL 14/2

Based on initial experiments carried out on the 8 in. dia. implosion-driven hypervelocity launcher, as well as on a preliminary design study of a larger launcher facility, the design of a 30 in. dia. hypervelocity launcher was completed, and a set of detailed workshop were prepared. The report describes the basic functioning of the implosion-driven hypervelocity launcher, as well as its mechanical design, operation and firing procedures. A separate section is devoted to the strength requirements and initial stressing. By using a simple analogy with a spherical pressure chamber, the authors endeavour to estimate the plastic/elastic stress level, from which some prediction of fatigue life for such a launcher was derived. The last two sections of this report give some recommendations for the proof-testing of the launcher, as well as some basic aspects regarding safety. Author (GRA)

N72-12201# Naval Research Lab., Orlando, Fla. Underwater Sound Reference Div.
DIGITAL-DATA OUTPUT CAPABILITY FOR HIGH-POWER IMPEDANCE MEASURING SYSTEM Final Report
C. W. Stoops 9 Aug. 1971 24 p
(NRL Proj. S02-30; RF Proj. 05-111-401-4471)
(AD-728381; NRL-MR-2305) Avail: NTIS CSCL 20/1

Modifications have been made to the high-power impedance system of the USRD Anechoic-Tank Facility, and a new subsystem has been designed and constructed to improve the measurement accuracy and increase the speed with which null-balance measurements can be made. The data developed by these measurements are both typed and punched out on tape by an ASR33 Teletype machine under the control of the new subsystem. Later, the information on the tape is supplied to a PDP-8/I computer for processing. The new equipment is described in detail. Author (GRA)

N72-12494# National Physical Lab., Teddington (England). Div. of Molecular Science.
THE NPL UTRASONIC TANK: ITS USES IN POLYMER

AND FIBRE COMPOSITE TESTING
M. F. Markham *In* AGARD Composite Mater. Sep. 1971 8 p refs (See N72-12492 03-18)
Avail: NTIS

N72-11872*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRANSONIC TESTING IN EXISTING WIND TUNNELS
J. Lloyd Jones *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 8 p refs (See N72-11854 03-01)
(NASA-TM-X-67415) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

N72-11879*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ON THE USE OF FREON-12 FOR INCREASING REYNOLDS NUMBER IN WIND-TUNNEL TESTING OF THREE DIMENSIONAL AIRCRAFT MODELS AT SUBCRITICAL AND SUPERCRITICAL MACH NUMBERS
Stuart L. Treon, William R. Hofstetter, and Frank T. Abbott *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 8 p refs (See N72-11854 03-01)
(NASA-TM-X-67417) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

N72-11880*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FACILITY CONCEPT FOR HIGH REYNOLDS NUMBER TESTING AT TRANSONIC SPEEDS
Donald D. Baals and George M. Stokes *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 12 p refs (See N72-11854 03-01)
(NASA-TM-X-67418) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

N72-11881# ARO, Inc., Arnold Air Force Station, Tenn. Von Karman Gas Dynamics Facility.
HIGH REYNOLDS NUMBER TRANSONIC WIND TUNNELS: BLOWDOWN OR LUDWIEG TUBE?
Jack D. Whitfield, C. J. Schueler, and Rogers F. Starr *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 17 p refs (See N72-11854 03-01)
(Contract F40600-71-C-0002)
Avail: NTIS HC $6.00/MF $0.95

N72-11882*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MSFC HIGH REYNOLDS NUMBER TUBE TUNNEL
A. Richard Felix *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 10 p refs (See N72-11854 03-01)
(NASA-TM-X-67419) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

N72-11883# Royal Aircraft Establishment, Farnborough (England).
SOME FACTORS RELEVANT TO THE SIMULATION OF FULL SCALE FLOWS IN MODEL TESTS AND TO THE SPECIFICATION OF NEW HIGH REYNOLDS NUMBER TRANSONIC TUNNELS
J. Y. G. Evans and C. R. Taylor *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 13 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

N72-11884# Advisory Group for Aerospace Research and Development, Paris (France).
AGARD STUDY OF HIGH REYNOLDS NUMBER WIND TUNNEL REQUIREMENTS FOR THE NORTH ATLANTIC TREATY ORGANIZATION NATIONS
Robert O. Dietz *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 9 p (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

N72-11885# Air Force Special Weapons Center, Holloman AFB, N.Mex.
HIGH REYNOLDS NUMBER TESTING BY MEANS OF ROCKET SLEDS
Hans J. Rasmussen *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 8 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N72-12202*# Fairchild Hiller Corp., Farmingdale, N.Y.
DETAILED INVESTIGATION OF FLOWFIELDS WITHIN LARGE SCALE HYPERSONIC INLET MODELS Final Report
William R. Seebaugh, Robert W. Doran, and Joseph P. DeCarlo Apr. 1971 256 p refs
(Contract NAS2-5719)
(NASA-CR-114305; FHR-4000) Avail: NTIS CSCL 20D

Analytical and experimental investigations were conducted to determine the characteristics of the internal flows in model passages representative of hypersonic inlets and also sufficiently large for meaningful data to be obtained. Three large-scale inlet models, each having a different compression ratio, were designed to provide high performance and approximately uniform static-pressure distributions at the throat stations. A wedge forebody was used to simulate the flowfield conditions at the entrance of the internal passages, thus removing the actual vehicle forebody from consideration in the design of the wind-tunnel models. Tests were conducted in a 3.5 foot hypersonic wind tunnel at a nominal test Mach number of 7.4 and freestream unit Reynolds number of 2,700,000 per foot. From flowfield survey data the inlet entrance, the entering inviscid and viscous flow conditions were determined prior to the analysis of the data obtained in the internal passages. Detailed flowfield survey data were obtained near the centerlines of the internal passages to define the boundary-layer development on the internal surfaces and the internal shock-wave configuration. Finally, flowfield data were measured across the throats of the inlet models to evaluate the internal performance of the internal passages. These data and additional results from surface instrumentation and flow visualization studies were utilized to determine the internal flowfield patterns and the inlet performance. Author

N72-12203# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
NUMERICAL PREDICTIONS OF SOME THREE DIMENSIONAL BOUNDARY LAYERS IN DUCTS
R. M. Curr, Devraj Sharma, and D. G. Tatchell Aug. 1971 35 p refs
(EF/TN/A/41) Avail: NTIS

Two numerical procedures were used to predict laminar, three-dimensional flow in rectangular-sectioned ducts. These predictions were compared with experimental data and theoretical analyses wherever available, and the agreement is

shown to be satisfactory. Results are also presented of two classes of previously unstudied flow situations. From a comparison of results obtained by the two methods, it is concluded that both yield solutions are of comparable accuracy and are equally versatile. Author

N72-12204# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
APPLICATION OF AN IMPROVED MIXING-LENGTH MODEL TO THE STUDY OF THREE-DIMENSIONAL TURBULENT BOUNDARY LAYERS [APPLICATION D'UN SCHEMA AMELIORE DE LONGUEUR DE MELANGE A L'ETUDE DES COUCHES LIMITES TURBULENTES TRIDIMENSIONNELLES]
Jean Cousteix, Claude Quemard, and Roger Michel 1971 11 p refs In FRENCH; ENGLISH summary Presented at the Reunion AGARD sur les Ecoulements Stratifies Turbulents, Londres, 13-15 Sep. 1971
(ONERA-TP-985) Avail: NTIS

An improved mixing-length model, previously applied to two-dimensional flow, is extended to cover the three-dimensional case, relying on the assumption that the turbulent shear stress acts in the same direction as the laminar. It is used to work out similar solutions to the local equations of a turbulent boundary layer with small cross-flow. In the general case of a compressible fluid with arbitrary pressure gradients, a digital routine enables the sets of transverse and longitudinal boundary-layer profiles and the wall skin-friction components to be determined as a function of two parameters expressing the influence of pressure gradients. A blow-by-blow comparison with available experimental results shows a fair measure of agreement. The model accordingly offers the requisite hypotheses on which to build an integral method of computing three-dimensional turbulent boundary layers. Author

N72-12205# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
VELOCITY DISTRIBUTION AT A SUPERSONIC COMPRESSOR INLET [REPARTITION DES VITESSES A L'ENTREE D'UN COMPRESSEUR SUPERSONIQUE]
Bernard Ledoux and Roger Bagot 1971 10 p In FRENCH; ENGLISH summary Presented at the Reunion AGARD sur les Entrees et Sorties de Propulseurs Aerospatiaux, Sandefjord, Norway, 13-17 Sep. 1971
(ONERA-TP-975) Avail: NTIS

Two methods were devised to determine radial velocities and their influence on the axial velocity profile. A direct method is described in which the ideal, compressible flow in the duct is determined from the duct and cowl shapes. The computed pressure distributions are compared with those indicated on the external shroud and the cowl during wind tunnel tests. From these data, the velocity distribution in the duct is deduced. The second method is an indirect one, based on the pressure distribution on the external wall and leading to flow field determination. The calculation is checked by comparing the streamline corresponding to the set-up inlet with the shape of the front cowl meridian. The two methods give coherent results. Author

N72-12206# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THEORETICAL AND EXPERIMENTAL STUDY OF THE COEXISTENCE OF TWO FLOWS IN A DUCT WITH CONSTANT CROSS SECTION [ETUDE THEORIQUE ET EXPERIMENTALE DE LA CO-EXISTENCE DE DEUX FLUX DANS UN CANAL DE SECTION CONSTANTE]
Jacques Paulon 1971 12 p refs In FRENCH; ENGLISH summary Presented at the Reunion AGARD sur les Entrees et Sorties de Propulseurs Aerospatiaux, Sandefjord, Norway, 13-17 Sep. 1971
(ONERA-TP-976) Avail: NTIS

Two-dimensional and asymmetrical set-ups with similar characteristics were built in order to study the coexistence, in a constant-section duct, of a supersonic jet inside a subsonic jet. The experimental analysis of the flow, made from pressure readings on the walls and inside the fluid, led to characterization of the actual limits of the two flows and the transition domain between them. In the two-dimensional case, the Schlieren visualization of the flow confirmed the measurements. The theoretical analysis, based on the method of characteristics, confirms the parietal readings. However the maximum flaring section given by this method differs from the sonic section of the external flow. This may lead to faulty prediction in the case of a contoured ejector. Author

N72-12207*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
VIBRATIONAL POPULATION DISTRIBUTIONS IN NONEQUILIBRIUM NOZZLE EXPANSION FLOWS Final Report
William S. Watt and Joseph W. Rich May 1971 43 p refs (Contract NASw-1843)
(NASA-CR-124615; CAL-RM-2731-A-1) Avail: NTIS
CSCL 20D

Experimental measurements and theoretical calculations of the vibrational population distribution in nonequilibrium nozzle expansion flows of gas mixtures are reported. These studies were directed toward determining whether vibrational energy exchange pumping could lead to laser action on the vibrational bands of a diatomic molecule. Three different types of experiments were conducted. These showed (1) that vibrational energy was preferentially transferred from N2 to CO in supersonic nozzle flows containing these gases; (2) that under some conditions this vibrational energy exchange pumping mechanism created population inversions in the vibrational levels of CO; and (3) that at large expansion ratios the magnitude of these population inversions was sufficient to sustain lasing in the nozzle. A theoretical model was developed to calculate vibrational state population distributions in gas dynamic expansions of a mixture of diatomic gases. Although only isothermal calculations have been completed, these data indicate that population inversions are predicted for conditions similar to those obtained in the nozzle expansion flows. Author

N72-12208# National Aeronautical Establishment, Ottawa (Ontario).
PARAMETRIC APPROXIMATIONS FOR COMPRESSIBLE LAMINAR BOUNDARY LAYERS WITH MASS TRANSFERS
Y. Y. Chan, A. R. Gower, and R. Kolanko Sep. 1971 46 p refs
(NRC-12236; LR-550) Avail: NTIS

The momentum integral method for laminar boundary layers according to Loitsianskii's universal equations approach has been extended to compressible flows with mass transfers. The universal forms of the compressible boundary layer equations are derived and series solutions in terms of the pressure gradient and the mass transfer parameters are obtained. The integral method with correlation calculated from these solutions predicts the velocity field with good accuracy. The energy field, however, is found to be less accurately predicted. Correlation functions for $Pr = 0.7$ and 1.0 and $g = 0.0$ to 2.0 are tabulated for practical uses. Author

N72-12209*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL WAKE SURVEY BEHIND A 140 DEG-INCLUDED-ANGLE CONE AT ANGLES OF ATTACK OF 0 DEG AND 5 DEG, MACH NUMBERS FROM 1.60 TO 3.95, AND LONGITUDINAL STATIONS VARYING FROM 1.0 TO 8.39 BODY DIAMETERS
Clarence A. Brown, Jr. and James F. Campbell Washington Nov. 1971 310 p refs
(NASA-TM-X-2409; L-7976) Avail: NTIS HC $6.00/MF $0.95
CSCL 20D

The flow properties in the wake of a 140 deg-included-angle cone at Mach numbers from 1.60 to 3.95 and at angles of attack of 0 deg and 5 deg are discussed. The wake flow properties are calculated from total and static pressures measured

with a pressure rake at longitudinal stations varying from 1.0 to 8.39 body diameters and at lateral stations varying from -0.42 to 3.0 body diameters. These measurements show a consistent trend throughout the range of Mach number and longitudinal distance and an increase in dynamic pressure with increasing longitudinal station. Author

N72-12210*# Dynamatec Corp., Cocoa Beach, Fla.
STUDY TO DEVELOP IMPROVED METHODS TO DETECT LEAKAGE IN FLUID SYSTEMS, PHASE 2
J. C. Janus and I. Cimerman 12 Sep. 1971 36 p
(Contract NAS10-7510)
(NASA-CR-124618; KSC-TR-1130; DC-71-4) Avail: NTIS CSCL 20D

An ultrasonic contact sensor engineering prototype leak detection system was developed and its capabilities under cryogenic operations demonstrated. The results from tests indicate that the transducer performed well on liquid hydrogen plumbing, that flow and valve actuation could be monitored, and that the phase change from gaseous to liquid hydrogen could be detected by the externally mounted transducers. Tests also demonstrate the ability of the system to detect internal leaks past valve seats and to function as a flow meter. Such a system demonstrates that it is not necessary to break into welded systems to locate internal leaks. Author

N72-12211*# Michigan State Univ., East Lansing. Div. of Engineering Research.
A STUDY OF THE ROUND JET/PLANE WALL FLOW FIELD Annual Report
John F. Foss and Stanley J. Kleis 8 Oct. 1971 203 p refs
(Grant NGR-23-004-068)
(NASA-CR-124604; AR-1) Avail: NTIS CSCL 20D

Impingement angles, between the axisymmetric jet axis and the plane wall, from zero to 15 degrees have been examined for nozzle heights of 0.75, 1.0, 1.5 and 2.0 diameters and for: (1) a fully developed pipe flow, and (2) a relatively uniform exit velocity condition. Velocity measurements have been used to define isotach contours and to determine mass, momentum and energy flux values for the near field (within five diameters) of the jet. Surface pressure measurements have been used to define surface pressure forces and jet centerline trajectories. The geometric and flow conditions examined and the interpretation of the results have been motivated by the externally blown flap STOL aircraft application. Author

N72-12212*# Techtran Corp., Glen Burnie, Md.
CESIUM VAPOR CONDENSATION FROM ARGON FLOWS
V. M. Borishanskiy, I. I. Palayev, K. M. Arefyev, N. I. Ivashchenko, T. V. Zablotskaya, B. M. Khomchenkov, and N. M. Fishman Washington NASA Nov. 1971 10 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 20, no. 4, Apr. 1971 p 600-606
(Contract NASw-2037)
(NASA-TT-F-14071) Avail: NTIS CSCL 20D

The condensation of small cesium vapor admixtures from laminar argon flows in tubes and turbulent flow in banks of tubes was studied under conditions where mist formation was likely to occur. It is found that for turbulent flow, mist formation in the boundary layer has only a slight effect on the diffusion condensation process. Calculations without allowance for mist formation and deposition are shown to lead to satisfactory results. Author

N72-12213# Lockheed Missiles and Space Co., Palo Alto, Calif.
SUPERSONIC DISSOCIATING GAS FLOW AROUND BLUNT BODIES AT AN ANGLE OF ATTACK
M. M. Golomazov [1971] 8 p refs Transl. into ENGLISH from Zh. Vychislitelnoi Mat. i Mat. Fiz. (Moscow), v. 11, no. 4, 1971 p 1063-1071
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A numerical scheme is developed for computing the equilibrium and nonequilibrium dissociating gas flow around blunt bodies at various angles of attack. The chemical reactions in the gas mixture behind the shock, which may also be equilibrium or nonequilibrium, are computed to the angle of attack. Author

N72-12214*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN EXACT CLOSED FORM SOLUTION FOR CONSTANT AREA COMPRESSIBLE FLOW WITH FRICTION AND HEAT TRANSFER
Jonas I. Sturas Washington Nov. 1971 18 p refs
(NASA-TN-D-6566; E-6426) Avail: NTIS CSCL 20D

The well-known differential equation for the one-dimensional flow of a compressible fluid with heat transfer and wall friction has no known solution in closed form for the general case. This report presents a closed form solution for the special case of constant heat flux per unit length and constant specific heat. The solution was obtained by choosing the square of a dimensionless flow parameter as one of the independent variables to describe the flow. From this exact solution, an approximate simplified form is derived that is applicable for predicting subsonic flow performance characteristics for many types of constant area passages in internal flow. The data included in this report are considered sufficiently accurate for use as a guide in analyzing and designing internal gas flow systems. Author

N72-12215*# Applied Theory, Inc., Los Angeles, Calif.
A NUMERICAL METHOD FOR COMPUTING THREE DIMENSIONAL VISCOUS SUPERSONIC FLOW FIELDS ABOUT SLENDER BODIES
Leonard Walitt and John G. Trulio Washington NASA Nov. 1971 103 p refs
(Contract NAS2-4998)
(NASA-CR-1963) Avail: NTIS CSCL 20D

A numerical method is presented for the calculation of steady, three-dimensional, viscous, compressible flow fields about slender bodies at angle of attack and at supersonic speeds. Approximations are introduced in modeling the flow in the longitudinal direction. Accordingly, the flow fields calculated with the program were computed with a model that permits viscous crossflow together with inviscid axial flow. An analysis of the errors introduced by such a treatment is presented. Numerical calculations were made and compared with experimental results for an ogive-cylinder and an airplane fuselage configuration. Generally, good agreement with experiment was obtained. However, boundary layer separation and body vortex positions differed from experimental locations on the ogive-cylinder, and the shock induced by the fuselage canopy was predicted at a slightly different location. Author

N72-12216*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOME CHARACTERISTICS OF TURBULENT BOUNDARY LAYERS IN RAPIDLY ACCELERATED FLOWS
Paul F. Brinich and Harvey E. Neumann Washington Dec. 1971 31 p refs
(NASA-TN-D-6587; E-6496) Avail: NTIS CSCL 20D

An analysis of time-mean-turbulent boundary layer velocity profiles measured in a rapidly accelerating flow suggests that the outer region of the velocity profiles consists of essentialiy inviscid, rotational flow. The extent of this inviscid outer region was observed in some cases to exceed 90 percent of what is ordinarily thought of as the turbulent boundary layer thickness. On the other hand, the inner frictional region of these velocity profiles appears to have turbulent characteristics similar to those of more conventional turbulent boundary layers. Hence, the outer edge boundary condition for this inner region is more properly the external rotational flow region than the free stream. Author

N72-12217# Carleton Univ., Ottawa (Ontario). Div. of Aerothermodynamics.
A MATRIX METHOD APPLIED TO THE ANALYSIS OF THE FLOW IN TURBOMACHINERY
W. R. Davis Sep. 1971 111 p refs
(ME/A-71-6) Avail: NTIS

A matrix technique for analyzing the flow conditions and performance of a turbomachine is described. The inviscid, rotational compressible flow field, with enthalpy and entropy gradients permitted, is determined by an iterative solution. A computer program for the above is described in detail and a FORTRAN listing provided. Author

N72-12218# Joint Publications Research Service, Washington, D.C.
ARTIFICAL CAVITATION
I. T. Yegorov, Yu. M. Adovnikov, I. I. Isayev, and M. A. Basin 8 Nov. 1971 361 p refs Transl. into ENGLISH from the book "Iskusstv. Kavitatsiya" Leningrad, Sudostr. Publ. House, 1971 284 p
(JPRS-54423; CSO-0267/72-S) Avail: NTIS HC $6.00/MF $0.95

The physical characteristics and basic laws defining the hydromechanical phenomena during artificial cavitation are described. Discussed in detail are: (1) physical characteristics of natural and artificial cavitation; (2) natural and artificial cavitation of hydrofoils; (3) controlling the lifting power of cavitating wings and venting bodies for interaction with a free water surface; (4) artificial cavitation of bodies moving near a free water surface; and (5) hydrodynamic characteristics of screw propellers under conditions of artificial cavitation. A.L.

N72-12219*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RESPONSE OF A RADIAL-BLADED CENTRIFUGAL PUMP TO SINUSOIDAL DISTURBANCES FOR NONCAVITATING FLOW
Douglas A. Anderson, Robert J. Blade, and William Stevans Washington Dec. 1971 53 p refs
(NASA-TN-D-6556; E-5877) Avail: NTIS CSCL 20D

A radial-bladed centrifugal pump was run in water with sinusoidal fluctuations of pressure and flow rate imposed at the pump inlet. Since the flow was noncavitating, zero gain was assumed in computing pump impedance. The inertive reactance became greater than the resistance at relatively low frequencies. An electric circuit model was developed in order to explain the trends of inertance and resistance with frequency. Author

N72-12220# Michigan Univ., Ann Arbor. Cavitation and Multiphase Flow Lab.
SPHERICAL DROPLET IMPINGEMENT ON FLAT RIGID SURFACE NON-SLIP BOUNDARY CONDITION
Yen C. Huang, F. G. Hammitt, and Wen-Jei Yang Nov. 1971 26 p refs Presented at the 4th Conf. on Fluid Mechanics and Fluid Machinery, Budapest, Nov. 1971
(Grant NSF GK-730)
(UMICH-03371-14-T) Avail: NTIS

The impact of spherical water drops upon a rigid non-slip plane is studied. The governing partial differential equations of compressible hydrodynamics neglecting body force, viscosity and surface tension are solved with a new compressible-cell-and-marker numerical technique. Flow patterns, impact pressures, and velocities are found as a function of time. As the liquid boundary is free to deform, compression and rarefaction take place simultaneously after the first instant of impact. However, the net effect of compression is predominate during the early stages of impact, until the radial lateral flow velocity exceeds the impact velocity, after which the pressures attenuate. The maximum pressure attained for liquid impact Mach numbers = 0.2 and 0.5 are about 60% of the theoretical one-dimensional water-hammer pressure as corrected for changed sonic velocity. This latter point is of considerable importance in estimating damage capability of such impacts. Author

N72-12221*# Scientific Translation Service, Santa Barbara, Calif.
TIME-DEPENDENT CALCULATION METHOD FOR TRANSONIC NOZZLE FLOWS
P. Laval Washington NASA Dec. 1971 37 p refs Transl. into ENGLISH of "Methode Instationnaire de Calcul de L'ecoulement Transsonique dans une Tuyere", French report ONERA-TN-173
(Contract NASw-2035)
(NASA-TT-F-14033; ONERA-TN-173) Avail: NTIS CSCL 20D

A time-dependent method is developed to compute mixed two-dimensional or axisymmetric flow in a nozzle with or without central body. The time-development equations of motion are used in conservative form, with transformed spatial independent variables. An explicit second-order accurate difference scheme, similar to a two-step Richtmeyer scheme, is set up with an artificial viscosity term. Results are presented for an annular nozzle and for five classical axisymmetric nozzles with small throat radius of curvature. Author

N72-12222*# Nielsen Engineering and Research, Inc., Mountain View, Calif.
CALCULATION OF COMPRESSIBLE NONADIABATIC BOUNDARY LAYERS IN LAMINAR, TRANSITIONAL AND TURBULENT FLOW BY THE METHOD OF INTEGRAL RELATIONS
Gary D. Kuhn Washington NASA Nov. 1971 132 p refs
(Contract NAS1-9429)
(NASA-CR-1797; NEAR-TR-25) Avail: NTIS CSCL 20D

A computer program was developed to do the calculations for two-dimensional or axisymmetric configurations from low speeds to hypersonic speeds with arbitrary streamwise pressure, temperature, and Mach number distributions. Options are provided for obtaining initial conditions either from experimental information or from a theoretical similarity solution. The transition region can be described either by an arbitrary distribution of intermittency or by a function based on Emmons' probability theory. Correlations were developed for use in estimating the parameters of the theoretical intermittency function. Correlations obtained from other sources are used for estimating the transition point. Comparisons were made between calculated and measured boundary layer quantities for laminar, transitional, and turbulent flows on flat plates, cones, cone flares, and a waisted body of revolution. Excellent agreement was obtained between the present theory and two other theories based on the method of finite differences. The intermittency required to reproduce some experimental heat transfer results in hypersonic flow was found to be quite different from the theoretical function. It is suggested that the simple probability theory of Emmons may not be valid for representing the intermittency of hypersonic transitional boundary layers and that the program could be useful as a tool for detailed study of the intermittency of the transition region. Author

N72-12223*# General Electric Co., Schenectady, N.Y. Research and Development Center
THE THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON MULTIPLE PURE TONE NOISE, PART 1
R. A. Kantola and M. Kurosaka Nov. 1971 157 p refs
(Contract NASw-1922)
(NASA-CR-1831) Avail: NTIS CSCL 21E

A theoretical and experimental investigation is described on multiple pure tone noise. Based on a two-dimensional and inviscid flow model, an analysis is developed to predict the generation and subsequent evolution of multiple pure tone noise from prescribed blade-to-blade nonuniformities in the rotor geometry. The results show that even small nonuniformities within manufacturing tolerances can cause a significant amount of multiple pure tone noise. Among the different kinds of nonuniformities investigated, errors in blade spacings are a weaker generator of multiple pure tone noise than errors in blade stagger or blade contours. Experimental investigations of the effects of the rotor relative Mach number, incidence angle and length of the inlet duct on the evolution of the multiple pure

tone noise are conducted with a known distribution of rotor nonuniformities. The model fan is operated, in Freon 12, in a closed loop acoustical facility. Author

N72-12224# Georgia Inst. of Tech., Atlanta.
WALL LAYER OF PLANE TURBULENT WALL JETS WITHOUT PRESSURE GRADIENT
James E. Hubbartt and Douglas H. Neale Jul. 1971 37 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Aircraft in Mar. 1972
(Contract DAHC04-68-C-0004)
Avail: NTIS

The friction coefficients and velocity profiles in the wall layer of constant-pressure turbulent wall jets with small initial boundary layers are presented. The experimental data is analyzed by systematically matching the velocity profile to the boundary layer law of the wall. The friction coefficients obtained from this analysis for large local velocity ratios (greater than about 2.5) are significantly higher than those obtained from Preston tube measurements. For velocity ratios near unity, the Preston tube results are apparently accurate, however, because the asymptotic approach to the law of the wall results in a substantial semi-logarithmic region. Matching to the law of the wall also provides a linear combination with the law of the wall which accurately expresses the velocity profiles for large velocity ratios. For smaller velocity ratios, an approximate expression for the velocity profile is obtained. Closed form expressions for the friction coefficients, useful for wall-jet analyses, are also presented. Author

N72-12225*# Vought Aeronautics, Dallas, Tex.
A STUDY OF BOUNDARY LAYER TRANSITION ON OUTGASSING CONES IN HYPERSONIC FLOW
C. J. Stalmach, Jr., J. J. Bertin, T. C. Pope, and M. H. McCloskey Washington NASA Dec. 1971 77 p refs
(Contract NAS1-9524)
(NASA-CR-1908) Avail: NTIS CSCL 20D

Surface heat-transfer rates and pressures were measured at hypersonic speeds on sharp cones at zero angle of attack with and without gas injection. Using the non-injection results for reference data the effects on heating and transition location of surface roughness and injectant rate, distribution and composition were determined. The transition location was sensitive to the injectant distribution. The transition Reynolds numbers were significantly greater when the injectant distribution was constant than with a variable distribution. The measured heat-transfer distribution were also strongly dependent upon the injectant distribution. Transition Reynolds number results obtained during this program with a variable injectant distribution were correlated with a limited amount of data available for a degrading model tested in a different facility. Transitional data with constant injectant distribution were correlated with earlier results. An empirical correlation of heat-transfer reduction due to gas injection in turbulent flow was developed for both distributions tested. Several effects of mass addition on heating and transition, which have been earlier reported, were observed. Author

N72-12226*# General Applied Science Labs., Inc., Westbury, N.Y.
CALCULATION OF TURBULENT BOUNDARY LAYERS WITH HEAT TRANSFER AND PRESSURE GRADIENT UTILIZING A COMPRESSIBILITY TRANSFORMATION. PART 1: SUMMARY REPORT
C. Economos and J. Boccio Washington NASA Dec. 1971 75 p refs
(Contract NAS1-9624)
(NASA-CR-1923; GASL-TR-748-Pt-1) Avail: NTIS CSCL 20D

The analysis uses a compressibility transformation and utilizes higher order closure rules to complete the transformation. By requiring that the momentum equations in differential form be satisfied at the wall and at the sublayer edge, correspondence rules are obtained which relate the variable property (VP) flow to a constant property (CP) flow in which mass transfer and pressure gradient occur simultaneously. A new CP formulation is developed and numerical results for a variety of cases are presented. Comparisons with earlier forms of the transformation and with experiment are included. For the zero pressure gradient case some differences between the various predictions are observed. For the several pressure gradient cases examined, the results are found to be essentially identical to those given by first order closure rules; i.e., by a form of transformation which relates the VP flow to a CP flow with pressure gradient but zero mass transfer. Author

N72-12227*# Alabama Univ., University. Bureau of Engineering Research.
TWO-PHASE FLOW AND HEAT TRANSFER IN POROUS BEDS UNDER VARIABLE BODY FORCES, PART 7 Final Report
Harold R. Henry May 1970 72 p refs
(Contract NAS8-21143)
(NASA-CR-121056; Rept-113-30-Pt-7; Rept-22-6560-Pt-7)
Avail: NTIS CSCL 20D

The design of an experiment to determine the behavior of two-phase vapor-liquid and gas-liquid flow through porous beds in low gravity environments is discussed. The selection of porous materials, liquids, and gases is described. The parameters necessary for the design and development of a flight experimental system are examined. The general specifications for system elements requiring additional development are identified. Author

N72-12228*# Unidev, Inc., Huntsville, Ala.
ANALYSIS OF CAVITATION BUBBLE DYNAMICS IN A LIQUID Final Report
L. L. Fontenot and Young Ching Lee Oct. 1971 65 p
(Contract NAS8-26489)
(NASA-CR-121057; UR-00013) Avail: NTIS CSCL 20D

General differential equations governing the dynamics of the cavitation bubbles in a liquid were derived. With the assumption of spherical symmetry the governing equations were simplified. Closed form solutions were obtained for simple cases, and numerical solutions were calculated for complicated ones. The growth and the collapse of the bubble were analyzed, oscillations of the bubbles were studied, and the stability of the cavitation bubbles were investigated. The results show that the cavitation bubbles are unstable, and the oscillation is not sinusoidal. Author

N72-12229*# Alabama Univ., Huntsville. Bureau of Engineering Research.
TWO PHASE FLOW AND HEAT TRANSFER IN POROUS BEDS UNDER VARIABLE BODY FORCES, PART 2 Final Report
James L. Evers and Harold R. Henry Nov. 1969 134 p refs
(Contract NAS8-21143)
(NASA-CR-121055; Rept-113-30-Pt-2) Avail: NTIS CSCL 20D

Analytical and experimental investigations of a pilot model of a channel for the study of two-phase flow under low or zero gravity are presented. The formulation of dimensionless parameters to indicate the relative magnitude of the effects of capillarity, gravity, pressure gradient, viscosity, and inertia is described. The investigation is based on the principal equations of fluid mechanics and thermodynamics. Techniques were investigated by using a laser velocimeter for measuring point velocities of the fluid within the porous material without disturbing the flow. Author

N72-12230# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
LAMINAR THEORY OF PERPENDICULAR SHOCKS
Harold Grad Jan. 1971 18 p refs Presented at the Collision-free Shocks in the Lab. and Space Conf., Frascati, Italy, 11-20 Jun. 1969
(Contract AT(30-1)-1480)

(MF-63; NYO-1480-170; ESRO-SP-51; Conf-690658-1) Avail: NTIS

This review is confined to the theory of laminar shocks in that there is no reference to instabilities or turbulence. A brief survey of the subject is given in terms of the relevant dimensionless parameters along with an account of the highly developed weak shock collisional structure and the scattered results known in collisionless theory. NSA

N72-12231# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Aachen (West Germany). Inst. fuer Theroretische Gasdynamik.

PROBLEMS OF THE PERTURBATION THEORY FOR WAVE PROPAGATION [PROBLEME DER STOERTHEORIE BEI WELLENAUSBREITUNGSVORGAENGEN]

A. Kluwick 1971 117 p refs In GERMAN; ENGLISH summary

(DLR-FB-71-18) Avail: NTIS; DFVLR, Porz, West Ger.: 28,20 DM

The assumptions for the derivation of the compatibility conditions of first order according to the analytical method of characteristics of K. Oswatitsch are investigated for three dimensional unsteady flows. Of special interest is the question whether all possible manifolds of characteristic surfaces are equivalent as basic elements of the theory. With regard to this question transonic flows have to be treated separately. It is shown that it is always possible to choose characteristic surfaces in such a way that the theory can be extended to transonic flows. This result is demonstrated by means of a numerical example which deals with an exact solution of the transonic potential equation. Author (ESRO)

N72-12232# Georgia Inst. of Tech., Atlanta.

TWO APPROACHES TO THE THREE-DIMENSIONAL JET-IN-CROSS WIND PROBLEM: A VORTEX LATTICE MODEL AND A NUMERICAL SOLUTION OF THE NAVIER-STOKES EQUATIONS Ph.D. Thesis

Joe Floyd Thompson, Jr. Jun. 1971 299 p refs

(Contract DAHC04-68-C-0004)

(AD-726366; AROD-T-2-22-E) Avail: NTIS CSCL 20/4

A three-dimensional numerical solution of the time-dependent, incompressible Navier-Stokes equations based on an integro-differential formulation of these equations is developed. With this formulation it is possible to obtain the complete solution in the entire flow field while restricting the actual computational field to the region of significant vorticity magnitude of each time. This allows a considerable reduction in the computer storage required, since only the field points having significant vorticity at any time need be stored at that time, and calculations are actually performed only at those points at that time. The validity of the numerical solution is established by comparison of the results with the exact solution for the time-dependent, one-dimensional flow over a suddenly accelerated infinite flat plate moving parallel to itself at constant velocity, and by comparison of surface pressure and drag coefficients with experimental results, and with the results of other numerical solutions for the two-dimensional flow about a circular cylinder. The numerical solution is applied to the flow field of an infinite jet in a cross-flow and to the flow field of a jet issuing perpendicularly from an infinite plane wall into a cross-flow parallel to the wall. Author (GRA)

N72-12233# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

EXPERIMENTAL STUDY OF TWO-DIMENSIONAL TURBULENT WALL JET DEVELOPMENT WITH AND WITHOUT LONGITUDINAL FREE STREAM PRESSURE GRADIENT

Douglas Howard Neale Jun. 1971 285 p refs

(Contract DAHC04-68-C-0004)

(AD-726025; AROD-T-2-21-E) Avail: NTIS CSCL 20/4

An experimental study of various wall jet flows was conducted. The major areas of investigation were: The wall jet injected into still air; The wall jet under a constant-pressure main-stream flow; The wall jet subjected to an adverse pressure gradient imposed by a retarded main-stream flow with a substantially thickened initial boundary layer; The wall jet subjected to an adverse pressure gradient imposed by a retarded main-stream flow with a thickened and distorted initial boundary layer. Detailed velocity profile and local skin friction measurements were made at numerous streamwise distances from the jet slot. For the case in which no main-stream flow was present, the studies were carried out for a wide range of slot Reynolds numbers. For the wall jets with main-stream flow, selected ratios of free-stream velocity to jet velocity at the jet slot were investigated. The growth of characteristic thickness and decay of jet peak velocity is presented for all wall jet studies. Also, velocity and temperature profile similarity is described. Skin friction laws are shown for the constant-pressure wall jets and a single 'law of the wall' valid for all wall jet studies is set forth. Finally, the skin friction and velocity profile measurements are presented in tabular form. Author (GRA)

N72-12234# Toronto Univ. (Ontario). Inst. of Aerospace Studies.

THE TRANSFER OF MASS, MOMENTUM AND ENERGY IN FREE PARTICLE AND TRANSITION FLOW SYSTEMS Final Report

Gordon N. Patterson Jan. 1971 249 p refs

(Grant AF-AFOSR-1481-68)

(AD-726097; AFOSR-71-1165TR) Avail: NTIS CSCL 20/4

A final report is made on the transfer of mass, momentum and energy in free-particle and transaction flow systems. It includes a state-of-the-art survey of the kinetic theory of gas flows based on reviews of basic background information. The report describes a study in the free particle regime in the hyperthermal free-molecule flow with application to satellite drag. Schomberg's reflection model is applied in the calculation of drag coefficients for convex bodies in free molecule flows and of the torque exerted on the Explorer 6 satellite. The same reflection model is also used for the calculation of the molecular transmission probability for conical tubes in hyperthermal free molecule flow. An experimental electron beam study of diffusive separation in transition-flow aerodynamic situations is noted. A method based on the studies has been developed to determine the ambient temperature and density of the major components of the upper atmosphere. Author (GRA)

N72-12235# ARO, Inc., Arnold Air Force Station, Tenn.

LOW-DENSITY SUPERSONIC SPHERE DRAG WITH VARIABLE WALL TEMPERATURE Final Report, 1 Dec. 1969 - 9 Sep. 1970

D. L. Whitfield and H. K. Smithson AEDC Jul. 1971 49 p refs

(Contract F40600-71-C-0002; AF Proj. 6682)

(AD-726092; AEDC-TR-71-83; ARO-VKF-TR-71-39) Avail: NTIS CSCL 20/4

Force measurements were made to investigate the effect of wall temperature on sphere drag in low-density supersonic flow. Drag data were obtained by fixing flow conditions and changing only the sphere wall temperature. A means of correlating drag data in transition flow is suggested, and its validity is assessed by applying the correlation parameter to this and several other sets of experimental data. Author (GRA)

N72-12236# Army Missile Command, Redstone Arsenal, Ala. Aeroballistics Directorate.

AN OUTLINE OF METHODS APPLICABLE TO VISCOUS FLUID FLOW PROBLEMS

T. H. Moulden and J. M. Wu Mar. 1971 84 p refs

(DA Proj. 1M2-62301-A-206)

(AD-728520; RD-TR-71-4) Avail: NTIS CSCL 20/4

Given the Navier-Stokes equations in general orthogonal curvilinear coordinates, specific equations for particular cases are indicated. In the notation of singular perturbation theory, the first approximation to the inner expansion (boundary-layer) is solved in simple cases. Some remarks are also made concerning

shock-wave boundary-layer interactions; in particular, no approximation to the equations is found in the immediate vicinity of the interaction. Base flows are also mentioned.
Author (GRA)

N72-12237# Denver Univ., Colo. Dept. of Mathematics.
ASYMPTOTIC METHODS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS WITH APPLICATION TO ENERGY PROPAGATION IN FLUID DYNAMICS Progress Report
N. Bleistein Jul. 1971 12 p
(Grant AF-AFOSR-1923-70; AF Proj. 9749)
(AD-728226; MS-7102; AFOSR-71-2178TR) Avail: NTIS CSCL 20/4

The report contains three sections: Analysis of internal waves in an inhomogeneous fluid, bifurcation in regular and singular eigenvalue problems, and asymptotic expansion of integrals.
Author (GRA)

N72-12238# California Univ., Berkeley. Div. of Aeronautical Science.
SYMMETRICAL FLOW PAST A DOUBLE WEDGE AT HIGH SUBSONIC MACH NUMBER
Jean-Jacques Chattot Jun. 1971 61 p refs
(Grant AF-AFOSR-0268-67; AF Proj. 9781-02)
(AD-728240; AS-71-3; AFOSR-71-2204TR; Task-61102F; Task-681307) Avail: NTIS CSCL 20/4

The symmetrical flow past a double wedge is studied for a high subsonic Mach number. The main features of the flow field are discussed in the physical and the hodograph plane. It is shown how a regular solution to the hodograph equation exhibits limit lines in the physical plane, which are eliminated through a 'cut' corresponding to the shock wave. The boundary value problem is solved in the hodograph plane using Telenin's method which has proven to be successful when dealing with equations of mixed type. Of particular interest is the point where the sonic line meets the shock.
GRA

N72-12239# Naval Ordnance Lab., White Oak, Md.
REFRACTION OF UNDERWATER EXPLOSION SHOCK WAVES: CALCULATIONS OF PRESSURE HISTORIES IN A CONVERGENCE ZONE
Ira M. Blatstein 24 Jun. 1971 34 p refs
(AD-728746; NOLTR-71-93; DASA-Subtask-NA-002/20; Problem-6) Avail: NTIS CSCL 19/4

In a previous report (NOLTR 69-181), a method was described for the prediction of underwater explosion shock wave pressure histories in caustic regions. In this report, the method is applied to the case of an ocean convergence zone. Quantitative agreement with experimental pressure histories from an ocean experiment is demonstrated for a region 4000 feet wide surrounding the caustic. The domain in which the solution is valid is discussed.
Author (GRA)

N72-12240# Naval Academy, Annapolis, Md.
SLOW TRANSVERSE MOTION OF A BODY IN A FINITE ROTATING FLUID
Richard B. Baxter 19 May 1971 42 p refs
(Proj. Trident Scholar)
(AD-728762; USNA-TSPR-13) Avail: NTIS CSCL 20/4

General properties of the Taylor column are studied by towing a cylinder along the bottom of a water filled tank rotating with constant angular velocity along an axis perpendicular to the direction of motion. Modification to the column resulting from limited axial extent of the fluid are studied by placing a solid boundary at various positions above the cylinder. The objective is to find a similarity rule which will relate the presence of this upper surface with an effective change in Rossby number. A region of influence which has not been predicted theoretically is found to exist immediately downstream of the Taylor column, and an attempt is made to observe and understand this disturbance.
Author (GRA)

N72-12241# Harry Diamond Labs., Washington, D.C.
FLUIDIC GENERATOR SYSTEM TO FIRE AIRCRAFT ROCKETS ENVIRONMENTALLY
Carl J. Campagnuolo, Clinton J. Sewell, and Clayton D. McKindra Jun. 1971 21 p refs Sponsored by NOL
(HDL Proj. 34734)
(AD-728105; HDL-TM-70-30) Avail: NTIS CSCL 13/7

A fluidic generator system for firing aircraft rockets has been developed to eliminate accidental firings of rockets while the aircraft is on the ground or on a carrier deck. The system increases safety of these rockets by denying a power supply to the squibs until specified flight conditions are met. Sufficient power to fire the rocket motors is provided by the fluidic generator only when the aircraft is airborne and has reached a speed of 200 knots. Flight tests of the system in the altitude range between 500 and 31,000 ft indicated that firing voltage (50 V dc) was reached in the velocity range between 210 to 260-knots indicated airspeed. This agreed well with laboratory results. No output voltage was recorded during an acoustic test conducted to determine the susceptibility of the generator to aircraft noise.
Author (GRA)

N72-12242# Virginia Polytechnic Inst., Blacksburg. Coll. of Engineering.
AN IMPLICIT NUMERICAL SOLUTION OF THE TURBULENT THREE DIMENSIONAL INCOMPRESSIBLE BOUNDARY LAYER EQUATIONS Interim Technical Report
F. J. Pierce and W. F. Klinksiek Jul. 1971 129 p refs
(Contract DAHC04-67-C-0008; DA Proj. 200-14501-B-33-G; AROD Proj. 6858-E)
(AD-728126; VPI-E-71-14; AROD-6858-6-E; ITR-3) Avail: NTIS CSCL 20/4

A method of solving the three-dimensional, incompressible turbulent boundary-layer equations was developed using a Crank-Nicholson implicit finite-difference technique, with the turbulent stress terms modeled with an eddy-viscosity model obtained from mixing length theory. The method was applied to two three-dimensional flow geometries for which experimental data exists and a comparison with this data showed excellent agreement. A complete computer program was sufficiently generalized for application to two-dimensional laminar and turbulent flows with arbitrary pressure gradients. The method was applied to several such test cases and the solutions agreed well with both theory and experiment. An analysis was presented to determine the conditions for which the finite difference equations were stable and convergent.
Author (GRA)

N72-12243# Naval Postgraduate School, Monterey, Calif.
THE EFFECT OF DILUTE POLYMER SOLUTION ON THE STROUHAL FREQUENCY OF CIRCULAR CYLINDERS
Richard Edward Kell Jun. 1971 89 p refs
(AD-728703) Avail: NTIS CSCL 20/4

Flow of aqueous solutions of Polyox WSR-301, at a concentration of 25 wppm, was investigated in the cylinder drag transition region of Reynolds numbers. Frequency spectrum and drag force were measured on a circular cylinder (diameter 1 inch). Frequency spectrum, Strouhal frequency and drag force also were measured on circular cylinders in water (diameter 1 and 1-1/2 inch). The polymer additive did not alter the vortex shedding frequency from that of water at the same Reynolds numbers. As the polymer degrades, a state is reached where concentration, Reynolds number and body size combination become such that the transition occurs in the boundary layer. Transition in the polymer solution occurred earlier than that in the pure solvent. At one Reynolds number, several regimes of flow may be observed as the polymer solution degrades.
Author (GRA)

N72-11887# Royal Aircraft Establishment, Farnborough (England).
A SCHEME FOR A QUIET TRANSONIC FLOW SUITABLE FOR MODEL TESTING AT HIGH REYNOLDS NUMBER
J. Y. G. Evans *In* AGARD Facilities and Tech. for Aerodyn.

Testing at Transonic Speeds and High Reynolds Number Aug. 1971 5 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N72-12244# Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG, URSI-CODE 131, MAY 1971 [IONOSPHAEREN-DATEN, VERTIKAL-ECHO-LOTUNG: FREIBURG, URSI-CODE 131, MAI 1971]
May 1971 43 p In GERMAN and ENGLISH
(Rept-230-F) Avail: NTIS

Daily summaries are presented for vertical echo sounding of the upper atmosphere over Freiburg, Germany during May 1971. The data include charts of median values for the E and F regions, MUF(3000)F2, M(3000)F2, h'F2, hpF2, foF1, MUF(3000)F1, h'F, foE, FoE2, h'E, foEs, h'Es, Type Es, foT, and fmin. Author

N72-12245# Fuerza Aerea Argentina, Buenos Aires.
GEOMAGNETIC ANNUAL, POLAR GEOPHYSICAL OBSERVATORY 1967 [ANALES GEOMAGNETICOS, OBSERVATORIO GEOFISICO PILAR, 1967]
1970 42 p In SPANISH
(Rept-18) Avail: NTIS

Geomagnetic data for 1967 are presented. Monthly tables of the hourly values of declination, horizontal component, and vertical component are included. Transl. by F.O.S.

N72-12246# Fuerza Aerea Argentina, Buenos Aires.
GEOMAGNETIC ANNUAL, LA QUIACA GEOPHYSICAL OBSERVATORY, 1966 [ANALES GEOMAGNETICOS, OBSERVATORIO GEOFISICO LA QUIACA, 1966]
1970 41 p In SPANISH
(Rept-17) Avail: NTIS

Geomagnetic data for 1966 are presented. Monthly tables of the hourly values of declination, horizontal component, and vertical component are included. Transl. by F.O.S.

N72-12247# Finnish Meteorological Inst., Helsinki.
OBSERVATIONS OF RADIOACTIVITY, 1970
1971 70 p ref
Avail: NTIS

Tables covering the measurement of short-lived beta activity in aerosols and long-lived beta activity in ground level aerosols for 1970 are given. Data cover fractions of aerosol beta decay within 4 hours and that remains for 4 days after the end of the sampling period. Measurements of beta activity in precipitation and settled dust collected at Helsinki and Ivalo are included. Additional measurements of fission products in the air were carried out in Finland. Graphs are also included. Author

N72-12248*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THIRD ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 1: GEOLOGY AND GEOGRAPHY
1970 275 p refs Conf. held at Houston, Tex., 1-3 Dec. 1970 Original contains color illustrations
(NASA-TM-X-67403; MSC-03742-Vol-1) Avail: NTIS CSCL 08F

Various aspects of geology and geography in the earth resources program are reviewed. Emphasis was placed on the data received from the Manned Spacecraft Center. For individual titles, see N72-12249 through N72-12268.

N72-12249*# Geological Survey, Washington, D.C.
INTRODUCTORY COMMENTS ON THE USGS GEOGRAPHIC APPLICATIONS PROGRAM
Arch C. Gerlach *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 5 p (See N72-12248 03-13)
Avail: NTIS CSCL 08F

The third phase of remote sensing technologies and potentials applied to the operations of the U.S. Geological Survey is introduced. Remote sensing data with multidisciplinary spatial data from traditional sources is combined with geographic theory and techniques of environmental modeling. These combined imputs are subject to four sequential activities that involve: (1) thermatic mapping of land use and environmental factors; (2) the dynamics of change detection; (3) environmental surveillance to identify sudden changes and general trends; and (4) preparation of statistical model and analytical reports. Geography program functions, products, clients, and goals are presented in graphical form, along with aircraft photo missions, geography test sites, and FY-70. J.A.M.

N72-12250*# Geological Survey, Washington, D.C.
CENSUS CITIES PROJECT AND ATLAS OF URBAN AND REGIONAL CHANGE c34
James R. Wray *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 16 p (See N72-12248 03-13)
Avail: NTIS CSCL 05K

The research design and imagery utilization for urban applications of remote sensing are reviewed, including the combined use of sensor and census data and aircraft and spacecraft sensor platforms. The related purposes of the Census Cities Project are elucidated: (1) to assess the role of remote sensors on high altitude platforms for comparative study of urban areas; (2) to detect changes in selected U.S. urban areas between the 1970 census and the time of launching of an earth-orbiting sensor platform prior to next census; (3) to test the satellite sensor platform utility to monitor urban change and serve as a control for sensor image interpretation; (4) to design an information system for incorporating graphic sensor data with census-type data gathered by traditional techniques; (5) to identify and to design user-oriented end-products or information services; and (6) to ascertain what organizational capability would be needed to provide such services on a continuing basis. A need to develop not only a spatial data information system, but also a methodology for detecting and interpreting change is implied. J.A.M.

N72-12251*# Iowa Univ., Iowa City. Inst. of Urban and Regional Research.
THE APPLICATION OF REMOTE SENSING TECHNIQUES TO SELECTED INTEP AND INTRA URBAN DATA ACQUISITION PROBLEMS c24
Frank E. Horton *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 12 p (See N72-12248 03-13)
Avail: NTIS CSCL 05K

The utility of remote sensing techniques to urban data acquisition problems in several distinct areas was identified. This endeavor included a comparison of remote sensing systems for urban data collection, the extraction of housing quality data from aerial photography, utilization of photographic sensors in urban transportation studies, urban change detection, space photography utilization, and an application of remote sensing techniques to the acquisition of data concerning intra-urban commercial centers. The systematic evaluation of variable extraction for urban modeling and planning at several different scales, and the model derivation for identifying and predicting economic growth and change within a regional system of cities are also studied. J.A.M.

N72-12252*# California Univ., Riverside. Dept. of Geography.
CLIMATOLOGY OF URBAN REGIONAL SYSTEMS
Robert W. Pease *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 11 p refs (See N72-12248 03-13)
Avail: NTIS CSCL 04A

The combining of remote sensing technologies to urban-regional energy climatology is studied. It was found to be three dimensional with a mosaic urban surface, each smaller surface with its own radiant and thermal properties. Urban patterns of radiant exchange were found to be constantly changing during diurnal and annual cycles. Results were derived from Barbados data using remote methods for monitoring and mapping radiation. Isoline maps of terrestrial radiation patterns were made generalizing the minute patterns of the scan image. J.A.M.

N72-12253*# Geological Survey, Washington, D.C.
REGIONAL LAND USE STUDIES
John L. Place *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 9 p (See N72-12248 03-13)
Avail: NTIS CSCL 02B

Remote sensing technology and data from instrumented satellites and high altitude aircraft are proposed for mapping land use on a current national basis, for monitoring changes and trends, and for creating statistical models which can be manipulated to demonstrate the probable effects of proposed land use and of environmental changes over large areas. Both Apollo spacecraft and aircraft photography were used; the spacecraft pictures delineated the cropland and urban boundaries more clearly. A computer model is also proposed for statistical analysis and for printing out updated maps automatically; this model will include a data bank which can be updated rapidly with changes detected by the computer. J.A.M.

N72-12254*# Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
ENVIRONMENTAL APPLICATION OF REMOTE SENSING METHODS TO COASTAL ZONE LAND USE AND MARINE RESOURCES MANAGEMENT
H. G. Goodell *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 9 p (See N72-12248 03-13)
Avail: NTIS CSCL 08C

The interrelationships of biophysical environmental systems are investigated. Social decision-making affecting the environments of a coastal megapolis are examined. Remote sensing from high altitude aircraft and satellites afforded a powerful and indepensible tool for inventory and planning for urban development. Repetitive low to medium altitude photography is also used for studying environmental dynamics, and to document the cultural impact of man on his environment. J.A.M.

N72-12255*# Office of Emergency Preparedness, Washington, D.C.
EXPERIMENTAL APPLICATIONS OF MULTISPECTRAL DATA TO NATURAL RESOURCE INVENTORY AND SURVEY
Harry J. Mallon *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 33 p refs (See N72-12248 03-13)
Avail: NTIS CSCL 08G

The feasibility of using multispectral, color, color infrared, thermal infrared imagery and related ground data to recognize, identify, determine and monitor the status of mineral ore and metals stockpiles is studied. An attempt was made to identify valid, unique spectral signatures of such materials for possible use under a wide variety of environmental circumstances. Research emphasis was upon the analysis of the multiband imagery from the various film-filter combinations, using density analysis techniques. Author

N72-12256*# Geological Survey, Washington, D.C.
SPECIAL PROJECTS OF THE GEOGRAPHIC APPLICATIONS PROGRAM
Gray W. North *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 7 p refs (See N72-12248 03-13)
Avail: NTIS CSCL 08F

Alternative uses were investigated for the Mississippi Test Facility since the phaseout of Saturn 5 engine testing. Using the facility for collecting remotely sensed data is suggested for regional studies. The capabilities of various remote sensing devices to detect, identify, monitor, or determine effects of environmental pollution are summarized. Which pollutants could be monitored from spacecraft, high and low altitude aircraft, and ground based platforms are determined. Examples of special processing and enhancement and analysis techniques used in connection with remote sensing data are provided. J.A.M.

N72-12257*# Geological Survey, Washington, D.C.
GEOGRAPHY PROGRAM, DESIGN, STRUCTURE AND OPERATIONAL STRATEGY
Robert H. Alexander *In* NASA. Manned Spececraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 9 p (See N72-12248 03-13)
Avail: NTIS CSCL 08F

The geography program is designed to move systematically toward a capability to increase remote sensing data into operational systems for monitoring land use and related environmental chang . The problems of environmental imbalance arising from rapid urbanization and other dramatic changes in land use are considered. These overall problems translate into working level problems of establishing the validity of various sensor-data combinations that will best obtain the regional land use and environmental information. The goal, to better understand, predict, and assist policy makers to regulate urban and regional land use changes resulting from population growth and technological advancement, is put forth. Author

N72-12258*# Michigan Univ., Ann Arbor.
PREPROCESSING OF MULTISPECTRAL DATA AND SIMULATION OF ERTS DATA CHANNELS TO MAKE COMPUTER TERRAIN MAPS OF A YELLOWSTONE NATIONAL PARK TEST SITE
Harry W. Smedes (Geol. Survey, Denver, Colo.), Margaret M. Spencer and Frederick J. Thomson *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1. 1970 25 p refs (See N72-12248 03-13)
Avail: NTIS CSCL 08B

The possibility of improving the accuracy of terrain classification by preprocessing spectral data was investigated. Terrain maps were made using the following techniques: 1) preprocessing by scan angle function transformation, using the computer-selected best set of three channels; and 2) preprocessing by ratio transformation, using the specified ERTS data channels, simulated by fitting the spectral response of each of the 12 data channels to the ERTS channels by a set of weighting coefficients. By using a simple technique during printout, the maps were produced in color. The normalized scan angle function transformation resulted in the most accurate classification. The best ratio transformation for the Yellowstone Park data was the ratio of each channel to the sum of all channels. A supervised training program involving maximum likelihood decision for selecting the best spectrometer channels and similar techniques for digitizing the data of the analog magnetic tapes were used. Cloud shadows were recognized in addition to eight classes of terrain. Preprocessing of data resulted in more accurate maps, required fewer training areas (hence less preparation and computer time), and enabled much of the area formerly classified as shadow to be reclassified according to actual terrain type. Author

N72-12259*# Geological Survey, Denver, Colo.
LINEAR GEOLOGIC STRUCTURE AND MAGIC ROCK DISCRIMINATION AS DETERMINED FROM INFRARED

DATA
T. W. Offield, L. C. Rowan, and R. D. Watson *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 12 p refs (See N72-12248 03-13)
Avail: NTIS CSCL 08G

Color infrared photographs of the Beartooth Mountains, Montana show the distribution of mafic dikes and amphibolite bodies. Lineaments that cross grassy plateaus can be identified as dikes by the marked constrast between the dark rocks and the red vegetation. Some amphibolite bodies in granitic terrain can also be detected by infrared photography and their contacts can be accurately drawn due to enchanced contrast of the two types of rock in the near infrared. Reflectance measurements made in the field for amphibolite and granite show that the granite is 25% to 50% more reflective in the near infrared than in the visible region. Further enhancement is due to less atmospheric scattering than in the visible region. Thermal infrared images of the Mill Creek, Oklahoma test site provided information on geologic faults and fracture systems not obtainable from photographs. Subtle stripes that cross outcrop and intervening soil areas and which probably record water distribution are also shown on infrared photographs. Author

N72-12260*# Geological Survey, Denver, Colo.
MULTISPECTRAL ANALYSIS OF LIMESTONE, DOLOMITE, AND GRANITE, MILL CREEK, OKLAHOMA
L. C. Rowan and Kenneth Watson *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 114 p refs (See N72-12248 03-13)
Avail: NTIS CSCL 08G

Spectral reflectance and thermal emission data were collected at the Mill Creek, Oklahoma test site during NASA missions 132 and 133 in June 1970. The data were collected by three aircraft flown several times during the diurnal cycle at altitudes of 150 to 17,000 m above mean terrain. Reflectance of the main rock types (limestone, dolomite, and granite) was determined from the data collected using a 12-channel multispectral scanner during mission 133 and from thermal infrared images recorded during mission 132 on an RS-7 scanner from 17,000 m above terrain. A preliminary rock recognition map was generated automatically using data collected from 900 m above terrain. The discrimination provided by the map is reasonably accurate. Misidentification occurred in areas of unusually high dolomite reflectivity. High altitude thermal infrared (10 to 12 micrometers) images show regional folds and faults distinguished by the presence of thermally contrasting materials. Linear and curvilinear structural features two to three times smaller than the nominal 17 m resolution could be detected. Author

N72-12261*# Geological Survey, Denver, Colo.
A THERMAL MODEL FOR ANALYSIS OF INFRARED IMAGES c19
Kenneth Watson *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 16 p refs (See N72-12248 03-13)
Avail: NTIS CSCL 12A

A mathematical model derived from the equation of heat conduction was developed to assist in interpreting thermal infrared images acquired from aircraft and spacecraft. The model assumes steady state boundary conditions. It contains parameters of rock and soil properties, atmospheric effects, site location, and season. The results predicted provide an explanation for the thermal differences among granite, limestone, and dolomite recorded in the December 1968 daytime and predawn flights over the Mill Creek, Oklahoma test site, during which representative thermal inertia and albedo values were used. A second test of the model made use of data acquired during the June 1970 predawn overflight of Mill Creek. A simple model of transient heating of the ground was constructed as an extension of the overall model, in order to examine the effects of atmospheric perturbations. The results obtained are consistent with those of ground observations made at the time of the overflight. Author

N72-12262*# Aerojet-General Corp., El Monte, Calif. Microwave Div.
A STUDY OF PASSIVE MICROWAVE TECHNIQUES APPLIED TO GEOLOGIC PROBLEMS
A. T. Edgerton *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 12 p (See N72-12248 03-13)
Avail: NTIS CSCL 08G

Passive microwave techniques were applied to geologic problems, in order to establish the microwave properties of representative rocks and minerals, and to examine the feasibility of using microwave radiometry for geologic mapping problems. A review of microwave pertaining to geology was conducted, coupled with laboratory and field investigations of the microwave emission characteristics of various geologic features. The laboratory studies consisted of dielectric constant measurements of rocks and minerals. A majority of field investigations conducted in the western United States, involved the microwave emission charateristics of rock types, and a portion of the study was concerned with microwave properties of mineralized areas. Experiments were also conducted in the vicinity of a coal seam fire in Colorado and across the San Andreas Fault Zone near the Salton Sea, in Southern California. Author

N72-12263*# Geological Survey, Washington, D.C.
GEOLOGIC INTERPRETATION OF APOLLO 6 STEREOPHOTOGRAPHY FROM BAJA CALIFORNIA TO WEST TEXAS
Stephen J. Gawarecki *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 25 p refs (See N72-12248 03-13)
Avail: NTIS CSCL 08G

Excellent space photography of parts of the southwestern United States and northwestern Mexico was obtained during the unmanned Apollo 6 spaceflight. Two features of this photography made it useful for geologic interpretations: its vertical stereocoverage and its exposure under a relatively low angle of solar illumination through an unusually cloud-free and clear atmosphere. The structural patterns, which were topographically enhanced by the longer shadows, were annotated on the photographs, in order to analyze their trends with respect to the continental tectonic framework, and to attempt to correlate the pattern with known copper or other base metal deposits. The annotated fracture patterns showed the regional trends and their distribution. The area studied was a 100- to 105-mile swath of terrain covering a total land area of approximately 60,000 square statute miles. The coverage began from a point centered on Punta Colnett on the Pacific coast of Baja California and extended to the Sacramento Mountains of New Mexico and west Texas. Author

N72-12264*# Geological Survey, Denver, Colo.
GEOLOGIC TERRAIN MAPPING FROM EARTH-SATELLITE AND ULTRA-HIGH AERIAL PHOTOGRAPHS
R. B. Morrison *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 5 p (See N72-12248 03-13)
Avail: NTIS CSCL 08B

A proposal is made for mapping from aerial photographs from the EROS program. Three kinds of maps (geomorphic or landform, soil, and surficial deposit) are being prepared at 1:250,000 scale for an 8000-square-mile area between Tucson and Ajo, Arizona. Nine cameras used on NASA mission 101 provided color, color infrared, and multispectral air photos from about 60,000 feet above the terrain and with photo scales ranging from 1:60,000 to 1:240,000. This area was selected because it provides a good sample of desert terrain and is suited for improving and testing the photointerpretive techniques for mapping geologic terrain features with small-scale photos.
Author

N72-12265*# Geological Survey, Menlo Park, Calif.
REMOTE SENSING IN MARINE GEOLOGY: ARCTIC TO CARIBBEAN

Paul R. Carlson *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 17 p refs (See N72-12248 03-13)
Avail: NTIS CSCL 08G

The applications of remote sensing to coastal dynamics of both nearshore and offshore waters are discussed. Results of aerial photographic analysis of four areas are presented. The study areas include the Arctic (Beaufort Sea), the Pacific Northwest, San Francisco Bay, and St. John, Virgin Islands (Project Tektite). Author

N72-12266*# Long Island Univ., Greenvale, N.Y.
RELATIONSHIP BETWEEN VEGETATION REFLECTANCE SPECTRA AND SOIL GEOCHEMISTRY: NEW DATA FROM CATHEART MOUNTAIN, MAINE
F. C. Canney (Geol. Survey, Denver, Colo.), Sondra Wenderoth, and Edward Yost *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 9 p (See N72-12248 03-13)
Avail: NTIS CSCL 08G

Spectral reflectance curves for red spruce and balsam fir in the 350- to 1100-nanometer region showed differences between specimens growing over and away from a concealed copper deposit at Catheart Mountain, Maine. A sample group of 15 anomalous spruce, 9 background spruce, 10 anomalous fir, and 10 background fir was studied. Measurements of copper and molybdenum contents in the supporting soil were used to categorize the trees as anomalous or background. Analyses using parametric and nonparametric statistical tests were performed to establish whether significatnt differences existed between the anomalous and background groups. At the 95% confidence level, significant differences were found to exist for both species, generally in the chlorophyll band centered at about 550 nanometers and in the region from 700 to 900 nanometers.
Author

N72-12267*# Bureau of Land Management, Washington, D.C.
GROUND TRUTH VERSUS NO GROUND TRUTH
Grover B. Torbert *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 3 p (See N72-12248 03-13)
Avail: NTIS CSCL 08G

The area of study was the southeastern Arizona test site and three areas within the site were studied in detail: Safford, Point of Pines, and Fort Apache-White River. These areas have terrain contrast ranging from flat arid regions to high alpine mountains. Data were obtained from the Apollo 9 photographic missions, high altitude aerial photography, and simulated ERTS-A data from high altitude aircraft. Various monoscopic and steroscopic devices were used to analyze the features, and film density variations were studied. No ground-based data were permitted. Thematic maps were prepared for geology, geomorphology, vegetation, hydrology, and soils. Interpreted boundaries were delineated, with no collaborative data used in the interpretation. Ground-based data were gathered during the overflight of high altitude aerial photography. A further study was made using the ground truth, and the data gathered on the ground were compared with original mapping. 80% to 85% of the interpretations in the areas checked were correct. It was proved that it is possible to monitor gross features of the vigor of crop lands and vegetative cover, to type soils and classify geologic features, and to determine hydrologic conditions.
Author

N72-12268*# Bureau of Indian Affairs, Washington, D.C.
A REVIEW OF APPLICATION STUDIES ON INDIAN LANDS USING NASA AEROSPACE IMAGERY
Arthur M. Woll *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 6 p (See N72-12248 03-13)
Avail: NTIS CSCL 08G

Three remote sensing projects are being conducted on three different Indian reservations in eastern Arizona. On the Fort Apache Reservation, a multiband thermal and false color sensing of an Englemann spruce beetle infestation is being investigated on Mount Baldy, adjacent to a U.S. Forest Service proposed winderness area. On the San Carlos Reservation, there is a joint USGS, EROS, and San Carlos tribe project to examine intensively a circular topographic feature noted on the Apollo 9 imagery. On the Papago Reservation, an EROS-funded contract will provide the Papago tribe with a report showing potential mineral areas, by comparing and correlating space imagery with high resolution imagery and aeromagnetic data. Author

N72-12269*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THIRD ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 2: AGRICULTURE, FORESTRY, AND SENSOR STUDIES
1970 640 p refs Conf. held at Houston Tex., 1-3 Dec. 1970 Original contains color illustrations
(NASA-TM-X-67404; MSC-03742-Vol-2) Avail: NTIS HC $9.00/MF $0.95 CSCL 02B

A review of various aspects of the Earth Resources Program is provided that places special emphasis on results of analysis of data obtained by aircraft or spacecraft. Remote sensors and data reduction techniques as applied to agriculture and forestry are outlined. For individual titles, see N72-12270 through N72-12294.

N72-12270*# Geological Survey, Washington, D.C.
CARTOGRAPHY
Alden P. Colvocoresses *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 13 p (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 08B

The EROS Cartography Program emphasizes the relationship between topographic activities of the U. S. Geological Service and those at the NASA Manned Spacecraft Center. Its objectives are to apply remote sensing systems on high altitude aircraft and orbiting satellites for topographic, planimetric, and thematic mapping of the earth's surface. The goal is to produce specially processed imagery from which useful information can be derived for a varity of disciplines associated with earth resources. G.G.

N72-12271*# Geological Survey, Washington, D.C.
AUTOMATIC CARTOGRAPHY TECHNIQUES FOR EARTH RESOURCES RESEARCH
Dean T. Edson *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 12 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 08B

Progress in developing instrumentation and software for the EROS user facilities is reported. Significant progress has been made in developing the USGS binary-mode scanning digitizer which is described in detail. Other instrumentation and processes discussed include profile-generating techniques, a manual digitizer, image correlation systems, and some new photomechanical data processing techniques. Author

N72-12272*# Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Research Div.
SPECTRAL REFLECTANCE FROM PLANT CANOPIES AND OPTIMUM SPECTRAL CHANNELS IN THE NEAR INFRARED
William A. Allen, Harold W. Gausman, and Craig L. Wiegand *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 12 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 08C

Theoretical and experimental aspects of the interaction of light with a typical plant canopy are considered. Both theoretical and experimental results are used to establish optimum electromagnetic wavelength channels for remote sensing in agriculture. The spectral range considered includes half of the visible and much of the near-infrared regions. Author

N72-12273*# Agricultural Research Service, Weslaco, Tex.
AERIAL PHOTOGRAPHY FOR SENSING PLANT ANOMALIES
H. W. Gausman, R. Cardenas, and W. G. Hart *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 15 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 02C

Changes in the red tonal response of Kodak Ektrachrome Infrared Aero 8443 film (EIR) are often incorrectly attributed solely to variations in infrared light reflectance of plant leaves, when the primary influence is a difference in visible light reflectance induced by varying chlorophyll contents. Comparisons are made among aerial photographic images of high- and low-chlorophyll foliage. New growth, foot rot, and boron and chloride nutrient toxicites produce low-chlorophyll foliage, and EIR transparency images of light red or white compared with dark-red images of high-chlorophyll foliage. Deposits of the sooty mold fungus that subsists on the honeydew produced by brown soft scale insects, obscure the citrus leaves' green color. Infected trees appear as black images on EIR film transparencies compared with red images of healthy trees. Author

N72-12274*# South Dakota State Univ., Brookings. Dept. of Plant Science.
REMOTE SENSING FOR DETECTION OF SOIL LIMITATIONS IN AGRICULTURAL AREAS
C. J. Frazee, R. D. Heil, and F. C. Westin *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 23 p (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 08M

Automatic analysis of soil limitations studied by an automatic color TV density slicing system was accomplished. This system color codes the density range of the value component of color of an image. Maps of soil limitations or other similar soil groups are produced by photographing the color coded representation of an area. The planimeter feature of the density slicing system measures the area of each soil limitation providing information on the importance of a soil limitation in an area. The results of this study suggest that an automatic color TV density slicing system has great potential not only for identifying and mapping similar soil areas, but also for indicating the percentage composition of an area. Author

N72-12275*# South Dakota State Univ., Brookings. Remote Sensing Inst.
RECOGNITION OF CROPS AND SOILS BY SPOT DENSITY MEASUREMENTS OF IMAGERY
Gerald D. Nelson *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 34 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 02C

Computerized techniques and methods were used to conduct preliminary soil and crop identification experiments. The soil identification experiment was conducted by making densitometer measurements on Ektachrome infrared film exposed at 14,000 feet. The density measurements were analyzed by plotting sample probability density functions, two-dimensional scatter plots, and the use of K-class I to determine the complete set of classification results for one, two, three and four features. Due to the presence of nineteen classes, crop identification experiments were more difficult to formulate. Classes of corn, fallow, harvested wheat, roadways, trees and water were classified 75 percent correct. Author

N72-12276*# Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Research Div.
THERMAL SCANNER DATA FOR STUDYING FREEZE CONDITIONS AND FOR AIDING IRRIGATION SCHEDULING
Jon F. Bartholic, Craig L. Wiegand, Ross W. Leamer, and Leo N. Namken *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 23 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 02C

The use of thermal imagery in connection with plant water stress appears to hold considerable potential, particularly with scanners such as the RS-14 where internal calibration sources can be adjusted to bracket the temperatures of interest. The data from the thermal film are fairly easy to reduce; however, data reduction in 3 days or less would be required before it could be used in irrigation timing. Author

N72-12277*# Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Research Div.
COMPUTER DISCRIMINATION PROCEDURES APPLICABLE TO AERIAL AND ERTS MULTISPECTRAL DATA
Arthur J. Richardson, Robert J. Torline, and William A. Allen *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 24 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 02C

Two statistical models are compared in the classification of crops recorded on color aerial photographs. A theory of error ellipses is applied to the pattern recognition problem. An elliptical boundary condition classification model (EBC), useful for recognition of candidate patterns, evolves out of error ellipse theory. The EBC model is compared with the minimum distance to the mean (MDM) classification model in terms of pattern recognition ability. The pattern recognition results of both models are interpreted graphically using scatter diagrams to represent measurement space. Measurement space, for this report, is determined by optical density measurements collected from Kodak Ektachrome Infrared Aero Film 8443 (EIR). The EBC model is shown to be a significant improvement over the MDM model. Author

N72-12278*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
THE APPLICATIONS OF REMOTE SENSING TO CORN BLIGHT DETECTION AND CROP YIELD FORECASTING
R. B. MacDonald *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 35 p (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 02C

Photography revealed the widespread and variable effects of southern corn leaf blight in Indiana. Three levels of severity of the infection could be discerned from good quality color and color infrared photography. As many as five severity levels appeared to be detectable and classifiable with multispectral scanner data and pattern recognition analysis. These conclusions are preliminary in nature, however, having been obtained from a limited amount of good quality scanner data collected over a small geographic area. Author

N72-12279*# California Univ., Berkeley. Forestry Remote Sensing Lab.
A SEMI-OPERATIONAL AGRICULTURAL INVENTORY USING SMALL SCALE AERIAL PHOTOGRAPHY
William C. Draeger and Lawrence R. Pettinger *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 28 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 02C

The feasibility of performing inventories of agricultural resources using very small scale aerial or space photography was studied. The results were encouraging on two counts: (1) The very practical problems of an operational survey are being faced and solutions are being found. (2) It seems that a fully operational agricultural inventory using space photography is not beyond the scope of present technology. Author

N72-12280*# California Univ., Berkeley. Forestry Remote Sensing Lab.
IMAGE RESOLUTION: ITS SIGNIFICANCE IN A WILDLAND AREA

Donald T. Lauer and Randolph R. Thaman *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 24 p (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 08F

The information content of simulated space photos as a function of various levels of image resolution was determined by identifying major vegetation-terrain types in a series of images purposely degraded optically to different levels of ground resolution resolvable distance. Comparison of cumulative interpretation results with actual ground truth data indicates that although there is definite decrease in interpretability as ground resolvable distance increases, some valuable information is gained by using even the poorest aerial photography. Developed is the importance of shape and texture for correct identification of broadleaf or coniferous vegetation types and the relative unimportance of shape and texture for the recognition of grassland, water bodies, and nonvegetated areas. Imagery must have a ground resolvable distance of at least 50 feet to correctly discriminate between primary types of woody vegetation. G.G.

N72-12281*# Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.
IDENTIFICATION AND MEASUREMENT OF SHRUB TYPE VEGETATION ON LARGE SCALE AERIAL PHOTOGRAPHY
Richard S. Driscoll *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 15 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 02F

Important range-shrub species were identified at acceptable levels of accuracy on large-scale 70 mm color and color infrared aerial photographs. Identification of individual shrubs was significantly higher, however, on color infrared. Photoscales smaller than 1:2400 had limited value except for mature individuals of relatively tall species, and then only if crown margins did not overlap and sharp contrast was evident between the species and background. Larger scale photos were required for low-growing species in dense stands. The crown cover for individual species was estimated from the aerial photos either with a measuring magnifier or a projected-scale micrometer. These crown cover measurements provide techniques for earth-resource analyses when used in conjunction with space and high-altitude remotely procured photos. Author

N72-12282*# Oregon State Univ., Corvallis. Dept. of Range Management.
A VEGETATIONAL AND ECOLOGICAL RESOURCE ANALYSIS FROM SPACE AND HIGH FLIGHT PHOTOGRAPHY
Charles E. Poulton, David P. Faulkner, and Barry J. Schrumpf *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 14 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 02C

A hierarchial classification of vegetation and related resources is considered that is applicable to convert remote sensing data in space and aerial synoptic photography. The numerical symbolization provides for three levels of vegetational classification and three levels of classification of environmental features associated with each vegetational class. It is shown that synoptic space photography accurately projects how urban sprawl affects agricultural land use areas and ecological resources. G.G.

N72-12283*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
REMOTE DETECTION OF INSECT EPIDEMICS IN CONIFERS
Robert C. Heller *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 36 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 02F

With properly exposed color or infrared color film, discolored foliage caused by insect infestations in ponderosa pine is detectable on moderately small-scale photographs with acceptable accuracies. Black and white photographs which matched the wavebands of the ERTS multispectral scanner were combined into one additive color photo. This imagery was not as useful as photographs taken on color, color infrared, or color film with a minus blue filter. Based on the high-altitude color and color infrared photos obtained, it is concluded that only insect infestations larger than 100 meters in diameter are detectable on ERTS imagery. Author

N72-12284*# Michigan Univ., Ann Arbor. School of Natural Resources.
MULTISPECTRAL SENSING OF MOISTURE STRESS
Charles E. Olson, Jr. *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 18 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 02F

Laboratory reflectance data, and field tests with multispectral remote sensors provide support for this hypotheses that differences in moisture content and water deficits are closely related to foliar reflectance from woody plants. When these relationships are taken into account, automatic recognition techniques become more powerful than when they are ignored. Evidence is increasing that moisture relationships inside plant foliage are much more closely related to foliar reflectance characteristics than are external variables such as soil moisture, wind, and air temperature. Short term changes in water deficits seem to have little influence on foliar reflectance, however. This is in distinct contrast to significant short-term changes in foliar emittance from the same plants with changing wind, air temperature, incident radiation, or water deficit conditions. Author

N72-12285*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
CLASSIFYING FOREST AND NONFOREST LAND ON SPACE PHOTOGRAPHS
Robert C. Aldrich *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 37 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 02F

Although the research reported is in its preliminary stages, results show that: (1) infrared color film is the best single multiband sensor available; (2) there is a good possibility that forest can be separated from all nonforest land uses by microimage evaluation techniques on IR color film coupled with B/W infrared and panchromatic films; and (3) discrimination of forest and nonforest classes is possible by either of two methods: interpreters with appropriate viewing and mapping instruments, or programmable automatic scanning microdensitometers and automatic data processing. Author

N72-12286*# Michigan Univ., Ann Arbor. Willow Run Labs.
SUMMARY OF MICHIGAN MULTISPECTRAL INVESTIGATIONS PROGRAM c14
Richard R. Legault *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 31 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 14B

The development of techniques to extend spectral signatures in space and time is reported. Signatures that were valid for 30 miles have been extended for 129 miles using transformation and sun sensor data so that a complicated multispectral recognition problem that required 219 learning sets can now be done with 13 learning sets. Author

N72-12287*# Michigan Univ., Ann Arbor. Willow Run Labs.
USER ORIENTED DATA PROCESSING AT THE UNIVERSITY OF MICHIGAN c08
Frederick J. Thomson *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 18 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 05B

The multispectral techniques have shown themselves capable

of solving problems in a large number of user areas. The results obtained are in some instances quite impressive. In many instances, the multispectral detection of various phenomena is an empirical fact for which there is little physical explanation today. To date, most of the user applications that have been addressed are exploratory in nature. The closest approximation to an operational situation encountered so far is that of the survey of wetlands in North Dakota reported in this paper. Author

N72-12288*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
THE APPLICATION OF AUTOMATIC RECOGNITION TECHNIQUES IN THE APOLLO 9 SO-65 EXPERIMENT **c14**
R. B. MacDonald *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 17 p (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 14E

A synoptic feature analysis is reported on Apollo 9 remote earth surface photographs that uses the methods of statistical pattern recognition to classify density points and clusterings in digital conversion of optical data. A computer derived geological map of a geological test site indicates that geological features of the range are separable, but that specific rock types are not identifiable. G.G.

N72-12289*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
THE DEVELOPMENT OF MACHINE TECHNOLOGY PROCESSING FOR EARTH RESOURCE SURVEY **c14**
D. A. Landgrebe *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 31 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 14E

The following technologies are considered for automatic processing of earth resources data: (1) registration of multispectral and multitemporal images, (2) digital image display systems, (3) data system parameter effects on satellite remote sensing systems, and (4) data compression techniques based on spectral redundancy. The importance of proper spectral band and compression algorithm selections is pointed out. G.G

N72-12290*# Kansas Univ./Center for Research, Inc., Lawrence.
REMOTE SENSING AT THE UNIVERSITY OF KANSAS IN RADAR SYSTEMS **c07**
Richard K. Moore *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 39 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 17I

Demonstration that a spectral response across an octave bandwidth in the microwave region is as variable as the comparable response in the visible and infrared region is a major mile-stone and indicates the potential of polypanchromatic radar systems is analogous with that of color photography. Averaging of the returns from a target element appears necessary to obtain a grey scale adequate for many earth-science applications of radar systems. This result can be obtained either by azimuth averaging or by the use of panchromatic techniques (range averaging). Improvement with panchromatic techniques has been demonstrated both with a landbased electromagnetic system and with an ultrasonic simulator. The advantage of the averaging achieved in azimuth with the real-aperture version of the DPD-2 when compared with the synthetic aperture version confirms the concept. Author

N72-12291*# Kansas Univ./Center for Research, Inc., Lawrence.
RECENT ADVANCES IN RADAR APPLICATIONS TO AGRICULTURE **c07**
Stanley A. Morain *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 27 p refs (See N72-12269 03-13)
(Contract NAS9-10261)
Avail: NTIS HC $9.00/MF $0.95 CSCL 17I

A series of remote radar sensing studies are summarized. These efforts comprise geoscience interpretations of such complex phenomena as those manifested in agricultural patterns. Considered are basic remote sensing needs in agriculture and the design and implementation of radar keys in the active microwave region as well as fine resolution radar imagery techniques for agriculture determinations and soil mapping. G.G.

N72-12292*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
INTERACTIVE DISPLAY/GRAPHICS SYSTEMS FOR REMOTE SENSOR DATA ANALYSIS **c07**
W. G. Eppler, D. L. Loe, E. L. Wilson, S. L. Whitley, and R. J. Sachen *In* Its 3d Ann. Earth Resources Program Rev., Vol. 2 1970 p 19 refs Prepared in cooperation with Lockheed Electronics Co., Houston, Tex. (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 17B

A color-television display system and interactive graphics equipment on-line to an IBM 360/44 computer are used to develop a variety of interactive displays which aid in analyzing remote sensor data. These interactive displays are used to: (1) analyze data from a multispectral scanner; (2) develop automatic pattern recognition systems based on multispectral scanner measurements; and (3) analyze data from non-imaging sensors such as the infrared radiometer and microwave scatterometer. Author

N72-12293*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex. Earth Observation Div.
RESULTS OF SCATTEROMETER SYSTEMS ANALYSIS FOR NASA/MSC EARTH OBSERVATION SENSOR EVALUATION PROGRAM **c14**
K. Krishen, N. Vlahos, O. Brandt, and G. Graybeal *In* Its 3d Ann. Earth Resources Program Rev., Vol. 2 1970 50 p refs Prepared in cooperation with Lockheed Electronics Co., Houston, Tex. (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 14B

A systems evaluation of the 13.3 GHz scatterometer system is presented. The effects of phase error between the scatterometer channels, antenna pattern deviations, aircraft attitude deviations, environmental changes, and other related factors such as processing errors, system repeatability, and propeller modulation, are established. Furthermore, the reduction in system errors and calibration improvement is investigated by taking into account these parameter deviations. Typical scatterometer data samples are presented. Author

N72-12294*# Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.
PHENOMENOLOGICAL APPROACH TO SCATTEROMETER DATA INTERPRETATION **c08**
F. E. Alzofon *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 8 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 05B

A graphic method of analyzing radar scatterometer sea clutter data leading to linear relations between scattering cross sections and tan angle of incidence of the radiation is proposed. This relation permits formulation of simple analytic relations without reference to the ocean surface spectrum. Parameters introduced depend on the wavelength of the incident radiation and its polarization, and on wind and sea states. The simplicity of the expressions derived suggests a corresponding simplicity in the physical mechanism of radar sea clutter return. Author

N72-12295*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THIRD ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 3: HYDROLOGY AND OCEANOGRAPHY
1970 351 p refs Conf. held at Houston, Tex., 1-3 Dec. 1970

Original contains color illustrations 3 Vol.
(NASA-TM-X-67405; MSC-03742-Vol-3) Avail: NTIS HC $6.00/MF $0.95 CSCL 08C

Hydrological and meteorological investigations undertaken in conjunction with the Earth Resources Program are briefly described along with discussions of important results obtained. For individual titles, see N27-12295 through N72-12318. For individual titles, see N72-12296 through N72-12319.

N72-12296*# Geological Survey, Miami, Fla.
DETECTION AND IDENTIFICATION OF BENTHIC COMMUNITIES AND SHORELINE FEATURES IN BISCAYNE BAY
Milton C. Kolipinski and Aaron L. Higer *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 16 p refs Sponsored by NASA (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 08B

Progress made in the development of a technique for identifying and delineating benthic and shoreline communities using multispectral imagery is described. Images were collected with a multispectral scanner system mounted in a C-47 aircraft. Concurrent with the overflight, ecological ground- and sea-truth information was collected at 19 sites in the bay and on the shore. Preliminary processing of the scanner imagery with a CDC 1604 digital computer provided the optimum channels for discernment among different underwater and coastal objects. Automatic mapping of the benthic plants by multiband imagery and the mapping of isotherms and hydrodynamic parameters by digital model can become an effective predictive ecological tool when coupled together. Using the two systems, it appears possible to predict conditions that could adversely affect the benthic communities. With the advent of the ERTS satellites and space platforms, imagery data could be obtained which, when used in conjunction with water-level and meteorological data, would provide for continuous ecological monitoring. A.L.

N72-12297*# South Dakota State Univ., Brookings. Remote Sensing Inst.
REMOTE SENSING FOR DEFINING AQUIFERS IN GLACIAL DRIFT
Victor I. Myers *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 20 p refs Sponsored by NASA and Geological Surv. (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 08H

Investigations were undertaken to determine the properties of shallow aquifers and related features that influence electromagnetic energy, to determine how these properties can be detected remotely, and to establish remote sensing procedures for aiding in ground water mapping. The direct influence of aquifier characteristics on surface thermal contrasts is discussed. Conclusions reached for late summer, predawn missions were: (1) Dynamic thermal changes near the surface can be used for thermal infrared sensing to detect shallow aquifers in glacial drift. (2) Under ideal conditions, surface temperatures may be used to predict certain features related to the occurrence of shallow aquifers. (3) The timing of missions and the optimum meteorological conditions occurring prior to and during the mission are critical for night thermal missions. (4) Repetitive flights made under variable conditions provide additional evidence to verify the occurrence of shallow aquifers. (5) Imagery from this investigation, along with ERTS-simulated imagery, indicates the feasibility of applying ERTS A and B data to reconnaissance studies for detection of shallow aquifers. A.L.

N72-12298*# South Dakota State Univ., Brookings. Remote Sensing Inst.
SUMMARY: REMOTE SENSING SOIL MOISTURE RESEARCH
Fred A. Schmer, Hal D. Werner, and Fred A. Waltz *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 9 p (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 08M

During the 1969 and 1970 growing seasons research was conducted to investigate the relationship between remote sensing imagery and soil moisture. The research was accomplished under two completely different conditions: (1) cultivated cropland in east central South Dakota, and (2) rangeland in western South Dakota. Aerial and ground truth data are being studied and correlated in order to evaluate the moisture supply and water use. Results show that remote sensing is a feasible method for monitoring soil moisture. Author

N72-12299*# Geological Survey, Tucson, Ariz.
MEASUREMENT OF PLANT COMMUNITY COVER FROM AERIAL PHOTOGRAPHS USING EKTACHROME INFRARED AERO FILM c14
Raymond M. Turner *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 8 p refs Sponsored by NASA (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

Color-IR aerial photographs of arid-zone vegetation have been used to estimate the amount of green plant material on the ground. The purpose has been to estimate plant cover as it varies with time and space and relate this vegetative measure to hydrologic conditions. Aerial photographs of the 6000-acre target area were taken periodically over a period of 3 years. Results of densitometeric analyses are presented. Author

N72-12300*# Geological Survey, Tacoma, Wash.
EMISSION CHARACTERISTICS OF SNOW AND ICE IN THE MICROWAVE RANGE
Mark F. Meier and A. T. Edgerton (Aerojet-Gen. Corp., El Monte, Calif.) *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1971 8 p Prepared in cooperation with Aerojet-Gen. Corp., El Monte, Calif. (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0/95 CSCL 08L

Some results are presented of a two year investigation on microwave emissions from snow. Included in the investigation were: theoretical studies; laboratory measurements of electrical properties of snow and similar materials; numerical modelling of hypothetical and real snowpacks; analysis of microwave data obtained on everflights; and quantative measurements of natural and artificial snowpacks made in the field. Results indicate that a fairly simple combination of microwave polarizations and frequencies can ultimately be used to monitor the water equivalent and free-water content as well as the distribution of snow. This understanding may also shed light on the physics of microwave emission from other wet, granular, layered media. Author

N72-12301*# Geological Survey, Albany, N.Y.
MANAGEMENT APPLICATIONS FOR THERMAL IR IMAGERY OF LAKE PROCESSES
J. M. Whipple and R. B. Haynes (RADC) *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1971 13p (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

A thermal infrared scanning program was conducted in the Lake Ontario Basin region in an effort to determine: (1) limonologic data that could be collected by remote sensing techniques, and (2) local interest in and routine use of such data in water management programs. Difficulties encountered in the development of an infrared survey program in New York suggest that some of the major obstacles to acceptance of remotely sensed data for routine use are factors of psychology rather than technology. Also, terminology used should suit the measurement technique in order to encourage acceptance of the surface thermal data obtained. A.L.

N72-12302*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SPECTRAL REFLECTANCE CHARACTERISTICS AND

AUTOMATED DATA REDUCTION TECHNIQUES WHICH IDENTIFY WETLAND AND WATER QUALITY CONDITIONS IN THE CHESAPEAKE BAY

Richard R. Anderson *In its* 3d Ann. Earth Resources Program Rev., Vol. 3 1970 29 p refs (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

Progress on research designed to test the usability of multispectral, high altitude, remotely sensed data to analyze ecological and hydrological conditions in estuarine environments is presented. Emphasis was placed on data acquired by NASA aircraft over the Patuxent River Chesapeake Bay Test Site, No. 168. Missions were conducted over the Chesapeake Bay at a high altitude flight of 18,460 m and a low altitude flight of 3070. The principle objectives of the missions were: (1) to determine feasibility of identifying source and extent of water pollution problems in Baltimore Harbor, Chesapeake Bay and major tributaries utilizing high altitude, ERTS analogous remote sensing data; (2) to determine the feasibility of mapping species composition and general ecological condition of Chesapeake Bay wetlands, utilizing high altitude, ERTS analogous data; (3) to correlate ground spectral reflectance characteristics of wetland plant species with tonal characteristics on multispectral photography; (4) to determine usefulness of high altitude thermal imagery in delinating isotherms and current patterns in the Chesapeake Bay; and (5) to investigate automated data interpretive techniques which may be usable on high altitude, ERTS analogous data. Author

N72-12303*# Geological Survey, St. Louis, Mo.

DATA RELAY SYSTEM SPECIFICATIONS FOR ERTS IMAGE INTERPRETATION

James F. Daniel *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 8 p refs (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

Experiments with the Data Collection System (DCS) of the Earth Resources Technology Satellites (ERTS) have been developed to stress ERTS applications in the Earth Resources Observation Systems (EROS) Program. Active pursuit of this policy has resulted in the design of eight specific experiments requiring a total of 98 DCS ground-data platforms. Of these eight experiments, six are intended to make use of DCS data as an aid in image interpretation, while two make use of the capability to relay data from remote locations. Preliminary discussions regarding additional experiments indicate a need for at least 150 DCS platforms within the EROS Program for ERTS experimentation. Results from the experiments will be used to assess the DCS suitability for satellites providing on-line, real-time, data relay capability. The rationale of the total DCS network of ground platforms and the relationship of each experiment to that rationale are discussed. Author

N72-12304*# Geological Survey, Harrisburg, Pa.

THE ROLE OF REMOTELY SENSED AND RELAYED DATA IN THE DELAWARE RIVER BASIN

Richard W. Paulson *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 19 p refs (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

A discussion is presented of the planned integration of the existing Delaware River Basin water quality monitoring and data processing systems with a data relay experiment proposed for the Earth Resources Technology Satellite (ERTS)-A, which will be launched in 1972. The experiment is designed to use ERTS-A as a data relay link for a maximum of 20 hydrologic stations in the basin, including streamgaging, reservoir level, ground water level, and water quality monitoring stations. This experiment has the potential for reducing the timelag between data collection and dissemination to less than 12 hours. At present there is a significant timelag between the time when the data are recorded at a monitoring site and the water resources agencies receive the data. The timelag exists because most of these instruments operate in remote locations without telementry, and the data records are removed manually, generally at a weekly frequency. For most water quality monitoring, the data do not reach water resources agencies for a period of 2 weeks to 2 months. Author

N72-12305*# National Oceanic and Atmospheric Administration, Washington, D.C.

NOAA'S OCEANOGRAPHY STUDIES UNDER THE EARTH RESOURCES SURVEY PROGRAM

E. Paul McClain *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1971 12 p refs Sponsored by NASA (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 08C

Some results are presented of Earth Resources Survey Program studies conducted on: (1) Defining and developing methods of suppressing system noise and cloud contamination in satellite measurements of infrared window radiation. (2) Relating sea surface temperature patterns in the Gulf Stream and Gulf of Mexico to associated thermal front structure with aid of infrared data from Nimbus or ITOS. (3) Testing the feasibility of mapping sea surface roughness and low level wind speed over tropical oceans by means of ATS imagery in sun glitter zones. (4) Microwave radiometer measurements from aircraft and their usefulness and limitations for all-weather mapping of surface roughness, sea ice conditions, and possible surface temperature. (5) Evaluation of scanning radiometer data from ITOS for purposes of mapping snow and ice conditions. Author

N72-12306*# National Oceanic and Atmospheric Administration, Washington, D.C.

NOAA'S HYDROLOGY STUDIES UNDER THE EARTH RESOURCES SURVEY PROGRAM

E. Paul McClain *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1971 9 p refs Sponsored by NASA (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 08H

Results are presented of investigations of soil moisture, snow cover, and lake temperatures carried out with the support of the Earth Resources Survey Program. Objectives of these studies were: (1) Obtain more data with a multifrequency microwave system so that the range of soil moisture amounts and types can be extended. (2) Establish instrument and data specifications for microwave sensing of soil moisture from satellites and aircraft. (3) Refine the procedures for mapping snow cover that have been developed using satellite and aircraft remote sensor data in the visible spectrum. (4) Evaluation of satellite and aircraft infrared observations for determining their information content with respect to snow cover, ice cover, and water temperature over large lakes. A.L.

N72-12307*# Oregon State Univ., Corvallis. Dept. of Oceanography.

REMOTE SENSING AND THE PELAGIC FISHERIES ENVIRONMENT OFF OREGON

William G. Pearcy *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 12 p refs (See N72-12295 03-13)
(Contracts N62306-70-C-0414; Bur-Com-Fish-14-17-17-0002-333)
Avail: NTIS HC $6.00/MF $0.95 CSCL 08A

Remote sensing oceanography at Oregon State University is part of a multidisciplinary research program: (1) to learn more about nearshore oceanographic processes and how they affect the production of marine life and the availability of albacore tuna; and (2) to provide fishermen with information in near real time that will be useful in scouting for albacore concentrations. Author

N72-12308*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

REMOTE SENSING OF OCEAN COLOR FROM AIRCRAFT c14

G. L. Clarke and G. C. Ewing *In its* 3d Ann. Earth Resources Program Rev., Vol. 3 1970 12 p refs (See N72-12295

03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

Over 3000 ocean spectra of sunlight backscattered from the upper layers of the sea have been obtained at flight altitudes to 10,000 feet together with detailed ground truth. These spectra are from stations which include a wide range of water masses differing as to biological and physical condition. This data bank and the analysis already performed demonstrates the probable feasibility of using ocean color as a parameter to locate areas of special significance to physical oceanographers and marine biologists from aircraft and satellites. Author

N72-12309*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THE REMOTE SENSING NEEDS OF ARCTIC GEOPHYSICS
William J. Campbell *In its* 3d Ann. Earth Resources Program Rev., Vol. 3 1970 15 p refs (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 08L

The application of remote sensors for obtaining geophysical information of the Arctic regions is discussed. Two significant requirements are to acquire sequential, synoptic imagery of the Arctic Ocean during all weather and seasons and to measure the strains in the sea ice canopy and the heterogeneous character of the air and water stresses acting on the canopy. The acquisition of geophysical data by side looking radar and microwave sensors in military aircraft is described. Author

N72-12310*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MEASUREMENT OF WATER DEPTH BY MULTISPECTRAL RATIO TECHNIQUES
F. C. Polcyn *In its* 3d Ann. Earth Resources Program Rev., Vol 3 1970 11 p (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 08C

The technique for measuring the depth of water using a multispectral scanner is discussed. The procedure takes advantage of the absorption properties of different wavelengths of light. Making use of the property of the selected transmission of light at different wavelengths, an equation was developed relating the outputs of at least two channels of multispectral scanner to measure water depth. Author

N72-12311*# Naval Research Lab., Washington, D.C.
RADAR MONITORING OF OIL POLLUTION
N. W. Guinard *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resoureces Program Rev., Vol. 3 1970 1 p (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95

Radar is currently used for detecting and monitoring oil slicks on the sea surface. The four-frequency radar system is used to acquire synthetic aperature imagery of the sea surface on which the oil slicks appear as a nonreflecting area on the surface surrounded by the usual sea return. The value of this technique was demonstrated, when the four-frequency radar system was used to image the oil spill of tanker which has wrecked. Imagery was acquired on both linear polarization (horizontal, vertical) for frequencies of 428, 1228, and 8910 megahertz. Vertical returns strongly indicated the presence of oil while horizontal returns failed to detect the slicks. Such a result is characteristic of the return from the sea and cannot presently be interpreted as characteristics of oil spills. Because an airborne imaging radar is capable of providing a wide-swath coverage under almost all weather conditions, it offers promise in the development of a pollution-monitoring system that can provide a coastal watch for oil slicks. Author

N72-12312*# TRW Systems Group, Redondo Beach, Calif.
VISIBLE REGION REMOTE SPECTROSCOPY OF POLLUTED WATER **c14**
Peter G. White *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 15 p (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

The use of an airborne spectrometer for measuring the amount of pollutants under the surface of a body of water is discussed. Difficulties created by high water absorption, atmospheric absorption, molecular scattering by water, and atmospheric scattering for the range of wavelengths from 0.2 to 20.0 microns are described. It was determined that some form of quantitative measurement of subsurface pollutants is possible using an airborne spectrometer. Author

N72-12313*# Atlantic Oceanographic and Meteorological Labs., Miami, Fla. Sea-Air Interaction Lab.
LASER OBSERVATIONS OF WAVE GROWTH AND FOAM DENSITY FOR FETCH LIMITED 25 M/SEC WINDS
Duncan B. Ross and Vincent Cardone (N. Y. Univ. Dept. of Oceanog. and Meteorol.) *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 27 p refs (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 08C

The variability of sea surface conditions has been observed from a low flying aircraft by a laser wave profiling system for fetch limited wind speeds of 25 M/SEC. in the North Sea. Wave profiles obtained with the laser system have been analyzed and show that wave growth occurs simultaneously at all frequencies and that an equilibrium value for the higher frequency components is eventually reached, but not before substantially higher (overshoot) values are obtained. Simultaneous photography of the surface has been analyzed and show that 32 percent of the surface is covered with white caps, foam and streaks. This result is in good agreement with a semi-empirical relationship incorporating both the wind speed and the local wave spectrum which predicts 26 percent white water for the conditions observed. Author

N72-12314*# California Univ., La Jolla. Visibility Lab.
WHITECAP COVERAGE FROM AERIAL PHOTOGRAPHY
Roswell W. Austin *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 11 p refs Supported by Naval Oceanog. Office (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 08C

A program for determining the feasibility of deriving sea surface wind speeds by remotely sensing ocean surface radiances in the nonglitter regions is discussed. With a knowledge of the duration and geographical extent of the wind field, information about the conventional sea state may be derived. The use of optical techniques for determining sea state has obvious limitations. For example, such means can be used only in daylight and only when a clear path of sight is available between the sensor and the surface. However, sensors and vehicles capable of providing the data needed for such techniques are planned for the near future; therefore, a secondary or backup capability can be provided with little added effort. The information currently being sought regarding white water coverage is also of direct interest to those working with passive microwave systems, the study of energy transfer between winds and ocean currents, the aerial estimation of wind speeds, and many others. Author

N72-12315*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ON THE USE OF A SINGLE BLUE BAND IN OCEANOGRAPHY
John W. Sherman, III *In its* 3d Ann. Earth Resources Program Rev., Vol. 3 1970 10 p refs (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95

The selection of a single blue band to quantitatively measure ocean chlorophyll is dependent upon the altitude and spectral bandwidth of the filter. These relationships are discussed, and the conclusion made that a blue band from 0.44 to 0.50 microns would best serve this oceanographic application. Author

N72-12316*# Naval Research Lab., Washington, D.C.
THE VARIATION OF RADAR CROSS SECTION WITH WIND c07
N. W. Guinard *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 1 p (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 17I

X-band (8910 megahertz) and C-band (4455 megahertz) measurements indicate that two domains exist in the variation of radar cross section with wind at incident angles far from the normal. The first domain for flow windspeeds is characterized by a rapid variation of radar cross section with wind and the second domain at higher windspeeds by an asymptotic approach to an upper limit (saturation). The transaction between the two domains occurs at a windspeed of approximately 10 knots. Recent Joint Ocean Surface Study I observations tend to confirm this observation and offer additional proof of the validity of a composite surface model which relates the radar cross section of the sea to the wave-height spectrum. This confirmation was obtained by comparing the radar cross section measured by the four-frequency radar system with the radar cross section calculated from the ocean wave-height spectrum that had been determined by the optical analysis of photographs taken at the same time. A possible explanation for the wind variation of the radar cross section of the open ocean also was evolved, based on radar measurements in a wave tank under various wind conditions and subsequent comparison with optically determined spectra.
Author

N72-12317*# Naval Research Lab., Washington, D.C. E. O. Hulburt Center for Space Research.
NANOSECOND RADAR OBSERVATIONS OF THE OCEAN SURFACE FROM A STABLE PLATFORM c07
B. S. Yaplee, A. Shapiro, B. D. Au, D. L. Hammond, and E. A. Uliana *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 15 p (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 17I

The measurement of ocean surface waves with a nanosecond radar pulse from a fixed platform at vertical incidence is discussed. By reducing the pulse width of radar until the pulse width resolves the vertical water wave structure, a set of radar returns is available to describe the ocean surface characteristics which differs from returns obtained by conventional radars. A block diagram of the radar and the principles of operation are presented.
Author

N72-12318*# Naval Research Lab., Washington, D.C. E. O. Hulburt Center for Space Research.
PASSIVE MICROWAVE STUDIES c14
James P. Hollinger *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 14 p refs (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

The application of passive microwave techniques from airborne and surface platforms for oceanography measurements is discussed. The program is designed to determine: (1) the optimum system parameters, (2) measurement techniques, and (3) the physical phenomena to enable unambiguous all-weather determination of the sea surface properties of sea roughness, surface wind fields, temperature, salinity, sea ice, and pollution. The advantages and disadvantages of the airborne and fixed station operations are examined.
Author

N72-12319*# New York Univ., N.Y. Dept. of Meteorology and Oceanography.
THE INTEGRATION OF REMOTE SENSING DATA INTO GLOBAL WEATHER PREDICTION, WAVE FORECASTING, AND OCEAN CIRCULATION COMPUTER BASED SYSTEMS c08
Willard J. Pierson, Jr. *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 27 p refs (See N72-12295 03-13)
(Contracts N62306-70-A-0075; N00014-67-A-0467-0012)
(Contrib-98) Avail: NTIS HC $6.00/MF $0.95 CSCL 09B

Data from infrared imaging systems and satellite infrared spectrometer (SIRS) for determining sea surface temperature and the atmospheric structure in cloudless areas over the oceans are discussed. Although some interpretations differ, it is clear that simultaneous measurements of radar sea return and passive microwave temperature will provide estimates of the wind speed, and perhaps wind direction, over the oceans, especially in cloudless areas, for a wide range of wind speeds. The problem of integrating the data that would be obtained by a spacecraft, especially one with a combination radar-radiometer, into global analysis procedures for meteorological, wave, and oceanographic predictions is described.
Author

N72-12320# Weapons Research Establishment, Adelaide (Australia).
ON THE ANALYSIS OF DATA FROM OPTICAL OZONE SONDES
N. V. Sissons Mar. 1970 50 p refs
(HSA-153) Avail: NTIS

Four synthetic ozone density profiles were used to predict the behavior of a proposed dropsonde system in the altitude range 75 to 20 km. It was found that the standard assumptions made in determining the ozone profile from rocket-borne absorption experiments are inadequate for ozone slant amounts in excess of .003 atm cm. A semiempirical correction was developed which gives a closer approximation to the true ozone profile in such cases. The effects of temperature and different solar spectral distributions upon the derived quantities were also analyzed.
Author

N72-12321*# National Aeronautics and Space Administration, Washington, D.C.
THE DUST-SAND FLOWS AND STORMS IN THE ATMOSPHERE FROM SPACE IMAGERY
B. V. Vinogradov, A. A. Grigoryev, and V. B. Lipatov Nov. 1971 13 p refs Transl. into ENGLISH of Leningrad Univ. conf. paper Presented at 22d Intern. Astronaut. Federation Congr., Brussels, Sep. 1971
(NASA-TT-F-14078) Avail: NTIS CSCL 04A

The application of spaceborne photography and television for mapping and analyzing dust storms in remote areas is discussed. Global photographs are perspective for a study of the dust-sand flows of maximum extension and for fixation of separate dust structures in the latitudinal systems. Regional television images provide the most valuable information on dust-sand flows and their relationship with meteorological situation.
Author

N72-12322*# National Aeronautics and Space Administration, Washington, D.C.
MAN-MADE ENVIRONMENT AS VIEWED FROM SPACE: WATER AND AIR POLLUTION
B. V. Vinogradov Nov. 1971 16 p refs Transl. into ENGLISH of Leningrad Univ. conf. paper p 1-16 Presented at the 22d Intern. Astronaut. Federation Congr., Brussels, Sep. 1971
(NASA-TT-F-14079) Avail: NTIS CSCL 13B

Detection and observation of air and water pollution using spaceborne sensors and manned spacecraft are discussed. Also, the requirement for development of a wide international program of observation and cooperation in the field of space surveillance and detection of the negative forms of man's influence on the environment is delineated. The development of such a global protection service will require that it be based on space methods whose applications transcend state and regional boundaries.
A.L.

N72-12323*# Iowa State Univ. of Science and Technology, Ames. Science and Humanities Research Inst.
A SEISMIC SURVEY OF THE MANSON DISTURBED AREA Final Report

Lyle V. A. Sendlein and Thomas A. Smith (Chevron Oil Co., Houston, Tex.) 25 Oct. 1971 107 p refs
(Grant NGR-16-002-028)
(NASA-CR-124629) Avail: NTIS CSCL 08K

The region in north-central Iowa referred to as the Manson disturbed area was investigated with the seismic refraction method and the bedrock configuration mapped. The area is approximately 30 km in diameter and is not detectable from the surface topography; however, water wells that penetrate the bedrock indicate that the bedrock is composed of disturbed Cretaceous sediments with a central region approximately 6 km in diameter composed of Precambrian crystalline rock. Seismic velocity differences between the overlying glacial till and the Cretaceous sediments were so small that a statistical program was developed to analyze the data. The program developed utilizes existing 2 segment regression analyses and extends the method to fit 3 or more regression lines to seismic data. Author

N72-12324*# Oregon Univ., Eugene. Center for Volcanology.
AN INVESTIGATION OF VOLCANIC DEPRESSIONS. PART 4: ORIGIN OF HOLE-IN-THE-GROUND, A MAAR IN CENTRAL OREGON Progress Report
Volker Lorenz [1971] 115 p refs
(Grant NGR-38-003-012)
(NASA-CR-115237) Avail: NTIS CSCL 08E

Hole-in-the-Ground, a volcanic explosion crater, located in central Oregon is described. The morphology of the soil and rocks and the topography of the crater indicate the sequential happenings during the eruption. Geophysical measurements also indicate a domical intrusion below the crater floor, extending upward as a ring dike around the margins of the crater. The volume of ejecta was determined for four major eruptions. Varied analyses were made of the pyroclastic debris, rocks, cinders, and soil. J.A.M.

N72-12325# Illinois Univ., Urbana. Dept. of Electrical Engineering.
INVESTIGATION OF THE PHYSICS OF DYNAMICAL PROCESSES IN THE TOPSIDE F REGION
L. A. Carpenter and S. A. Bowhill 15 Sep. 1971 224 p refs
(Grant NSF GA-27295)
(UILU-ENG-71-2503; Rept-44) Avail: NTIS

The physics of Thomson scatter and transport processes in a plasma is described, and the technique for determining plasma drifts is developed. Observations at altitudes between 450 and 750 km were used to construct a description of the behavior of the ionosphere. Seven 24-hr operations in 1968 are examined in detail and were grouped as late summer, equinox, winter and disturbed conditions. The diurnal behavior of the vertical velocity was studied, as well as the short-period fluctuations in this vertical velocity that are superposed on the diurnal behavior. These fluctuations are attributed to traveling ionospheric disturbances. The vertical transport processes are examined for midlatitudes and compared with measured vertical velocity. Diurnal variation and altitude variation were used to assess their relative effect during different times of day. The ionosphereplasmasphere coupling and the maintenance of nighttime ionosphere are examined. Author

N72-12326*# Texas Univ., Dallas.
CHARACTERISTICS OF MAGNETOSHEATH PLASMA OBSERVED AT LOW ALTITUDES IN THE DAYSIDE MAGNETOSPHERIC CUSPS
J. David Winningham 7 Jul. 1971 26 p refs Presented at the Summer Advanced Inst. on Earth's Particles and Fields, Cortina, Italy, 20 Aug. - 10 Sep. 1971
(Contract NAS5-9112)
(NASA-CR-122301; Rept-71-0-1918) Avail: NTIS CSCL 03B

Magnetosheath plasma penetrating to low altitudes in the dayside cusp region of the magnetosphere has been observed by the ISIS 1 soft particle spectrometer (SPS). The extent of these particle fluxes in local magnetic time and invariant latitude, their variation with magnetic activity, and their pitch angle distribution are given. Comparison between the SPS data and energetic particle data indicates that the boundary between open and closed field lines on the dayside is associated with a sharp drop in the outer zone > keV electron fluxes. It is shown that these newly identified cusp fluxes provide the necessary energy to produce observed dayside auroral oval phenomena. Author

N72-12327*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WIND-DRIVEN CURRENTS IN A SHALLOW LAKE OR SEA
Marvin Goldstein and Richard T. Gedney 1971 27 p refs Presented at the Fluid Dyn. Div. Meeting of the Am. Phys. Soc., San Diego, 22-24 Nov. 1971
(NASA-TM-X-67952; E-5617) Avail: NTIS CSCL 08J

For shallow lakes and seas such as the great lakes (especially Lake Erie) where the depth is not much greater than the Ekman depth, the usual Ekman dynamics cannot be used to predict the wind driven currents. The necessary extension to include shallow bodies of water, given by Welander, leads to a partial differential equation for the surface displacement which in turn determines all other flow quantities. A technique for obtaining exact analytical solutions to Welander's equation for bodies of water with large class of bottom topographies which may or may not contain islands is given. It involves applying conformal mapping methods to an extension of Welander's equation into the complex plane. When the wind stress is constant (which is the usual assumption for lakes) the method leads to general solutions which hold for bodies of water of arbitrary shape (the shape appears in the solutions through a set of constants which are the coefficients in the Laurent expansion of a mapping of the particular lake geometry). The method is applied to an elliptically shaped lake and a circular lake containing an eccentrically located circular island. Author

N72-12328*# Aerojet-General Corp., El Monte, Calif. Microwave Div.
MICROWAVE RADIOMETRIC INVESTIGATIONS OF MINE SUBSIDENCE IN ROCK SPRINGS, WYOMING Final Report
A. T. Edgerton, F. Ruskey, and D. N. Williams Jan. 1971 96 p refs Sponsored by NASA
(Contract BM-HO-110156)
(NASA-CR-123480; Rept-1721-2;
NASA-Task-160-75-73-04-10; IR-USGS-217) Avail: NTIS CSCL 08G

Investigations were made in two areas where mapping techniques are needed for locating abandoned coal mines and subsidence-prone areas. Microwave surveys were conducted specifically to map the overburden moisture distribution resulting from the subsurface geology. The microwave radiometric maps and supporting data were analyzed in terms of both surface and subsurface phenomena, and were compared with the available subsurface information. Data from the 21 cm line showed better response to subsurface conditions and were used for all detailed sensor analyses. Preferential distribution of near-surface moisture was observed on both sites. A major subsurface feature was located that extended more than 750 feet. This feature exhibited a positive microwave signature that correlates closely with a large haulage tunnel in the No. 7 coal seam, which occurs at a depth of 160 feet. At this location there is no surface evidence of subsidence and the anomaly is believed to be associated with active subsidence which has not reached the surface. Several other anomalies were attributed to factors unrelated to mining activities or subsidence. Author

N72-12329*# Earth Satellite Corp., Washington, D.C.
REMOTE SENSING FOR MINED AREA RECLAMATION: APPLICATION INVENTORY
1 Jun. 1971 40 p ref Sponsored by NASA
(NASA-CR-124608; NASA-Task-160-75-73-04-10;
IR-USGS-218) Avail: NTIS CSCL 08G

Applications of aerial remote sensing to coal mined area

reclamation are documented, and information concerning available data banks for coal producing areas in the east and midwest is given. A summary of mined area information requirements to which remote sensing methods might contribute is included.
Author

N72-12330*# Metropolitan Washington Council of Governments, D.C.
LAND USE DETERMINATION BY REMOTE SENSOR ANALYSIS
Harry J. Mallon and Joan Y. Howard Aug. 1971 74 p refs
(NASA Order W-13318; Contract DI-14-08-0001-12708)
(NASA-CR-124607; NASA-Task-160-75-71-03; IR-USGS-220)
Avail: NTIS CSCL 08G

A land use analysis of 18 selected census tracts in the Metropolitan Washington area using aerial photography was undertaken. A comparison of the results was made with comparable land use data from the Metropolitan Washington Council of Governments' Parcel File, and the results reported. Summary conclusions and recommendations for the use of photo-derived data in land use studies by COG are made.
Author

N72-12331*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IONOSPHERIC nf SUB H RESONANCES: FREQUENCY SHIFTS VERSUS PLASMA CONDITIONS
Robert F. Benson Oct. 1971 29 p refs
(NASA-TM-X-65565; X-621-71-214; TID-50551) Avail: NTIS CSCL 03B

The Alouette 2 resonances observed near the harmonics of the electron cyclotron frequency f sub H reveal frequency shifts (relative to the n(f sub H) values derived from model field calculations) which can be interpreted in terms of plasma wave dispersion effects. These effects are observed on the 2(f sub H) resonance when it is near the resonance observed close to the upper hybrid frequency f sub T. The observations suggest that an oblique echo model may be required to give a proper interpretation of the 2(f sub H) resonance. Cyclotron damping can be ignored only when the angle between the propagation vector and the direction perpendicular to the earth's magnetic field B is less than a few degrees for the 2(f sub H) wave, and less than a few tenths of a degree for the n(f sub H) waves with $n > 2$. The negative offset of the absolute value of B inferred from the plasma resonance observations is consistent with expectations based on recent OGO 3 and OGO 5 rubidium magnetometer observations at higher altitudes in the equatorial regions. Author

N72-12332# Weapons Research Establishment, Adelaide (Australia).
IONOSPHERIC DATA FOR JULY 1970 FROM SALISBURY, SOUTH AUSTRALIA
Jul. 1971 28 p
(SAD-1970/7(S)) Avail: NTIS

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for July 1970.
Author

N72-12333# National Physical Lab., New Delhi (India). Radio Propagation Unit.
SOLAR AND GEOPHYSICAL DATA, PART 2, JULY 1971
Jul. 1971 9 p
(RRC-A-193-Pt-2; SG-66) Avail: NTIS

Predicted and observed solar and geophysical data for June 1971 are presented in tables and graphs. The data include sunspot numbers, solar flux, solar flares and their effects, magnetic storms, and SID effects.
Author

N72-12334# Joint Publications Research Service, Washington, D.C.
METHODS FOR CLEAN CONDENSATION OF ATMOSPHERIC MOISTURE FOR ITS USE IN A CLOSED ECOLOGICAL SYSTEM
G. P. Khomchenko, S. V. Chizhov, Yu. Ye. Sinyak, V. F. Stolbov, M. I. Shikina, and V. V. Krasnoshchekov 17 Nov. 1971 9 p refs Transl. into ENGLISH from Izv. Timiryazevskoy, Selsko-Khozyaystvennoy Akad. (Moscow), no. 5, 1971 p 184-190
(JPRS-54502; UDC-613.693:628.16.0809; CSO-0929/72-W)
Avail: NTIS

Various techniques for retrieving atmospheric humidity condensates for use in life support systems are examined. The feasibility of using the organic and inorganic condensates as drinking water and preparing feed solutions for growing higher and lower plants on prolonged space flights is also discussed. Biological and toxicological evaluation of the recovered water indicates that it can be used for the above purposes. E.H.W.

N72-12335*# National Oceanic and Atmospheric Administration, Boulder, Colo.
A ROCKET BORNE INSTRUMENT TO MEASURE ELECTRIC FIELDS INSIDE ELECTRIFIED CLOUDS
L. H. Ruhnke May 1971 32 p refs
(NASA-CR-124635; NOAA-TR-ERL-206-APCL-20) Avail: NTIS; SOD $0.40 Stock No. 0317-0036 CSCL 04A

The development of a rocket borne instrument to measure electric fields in thunderstorms is described. Corona currents from a sharp needle atop a small rocket are used to sense the electric field. A high ohm resistor in series with the corona needle linearizes the relationship between corona current and electric field. The corona current feeds a relaxation oscillator, whose pulses trigger a transmitter which operates in the 395 to 410 MHz meteorological band. The instrument senses fields between 5 kV/m and 100 kV/m.
Author

N72-12336*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GLOBAL DISTRIBUTION OF TOTAL OZONE DERIVED FROM NIMBUS 3 SATELLITE DURING APRIL–JULY, 1969 AND ITS IMPLICATION TO UPPER TROPOSPHERIC CIRCULATION
C. Prabhakara (Allied Res. Assoc.), E. B. Rodgers, and V. V. Salomonson Nov. 1971 32 p refs
(NASA-TM-X-65774; X-651-71-463) Avail: NTIS CSCL 04A

Utilizing a stepwise multiple regression scheme, monthly mean global maps of total ozone are produced from the spectral intensity measurements made by the infrared interferometer spectrometer (IRIS) onboard the Nimbus 3 satellite for the period April 18 to July 22, 1969. These maps show that over the equatorial regions total ozone increases steadily from April to July. Further, latitudinal variation of total ozone derived from these maps shows that the ozone increases at all latitudes over the Southern Hemisphere uniformly from April to July while over the Northern Hemisphere the monthly decrease at all latitudes is nonuniform. In general, these maps bear a close resemblance to the upper tropospheric circulation. It is observed that the total ozone is best correlated with the 200 mb geopotential heights. This relationship enables the utilization of total ozone as a quasi-stream function to determine geostrophic winds at 200 mb level. Further, even at low latitudes where the total ozone does not bear simple relationship to the geopotential heights the course of the easterly jet stream with the help of the ozone measurements can be identified.
Author

N72-12337*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC FIELD MEASUREMENTS BY PIONEER 7. 1: HOURLY AVERAGES OF THE FIELD ELEMENTS FROM 17 AUGUST 1966 TO 29 OCTOBER 1967 (BARTEL'S SOLAR ROTATION 1820 TO 1836)
Norman F. Ness and Franklin W. Ottens Nov. 1971 42 p refs
(NASA-TM-X-65769; X-690-71-452) Avail: NTIS CSCL 03C

The magnetic observations of Pioneer 7, located in the aftward portion of the disturbed solar plasma caused by

interaction with the geomagnetic field, are summarized in graphical form. Hourly averages of the magnetic field elements for Bartel's solar rotation number are shown for each month from August 1966 to October 1967. F.O.S.

N72-12338*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMAL COEFFICIENTS OF TECHNOLOGY ASSIMILATION BY NATURAL SYSTEMS
Robert F. Mueller Oct. 1971 12 p refs Submitted for publication
(NASA-TM-X-65765; X-644-71-418) Avail: NTIS CSCL 08D

Estimates of thermal coefficients of the rates of technology assimilation processes was made. Consideration of such processes as vegetation and soil recovery and pollution assimilation indicates that these processes proceed ten to several hundred times more slowly in earth's cold regions than in temperate regions. It was suggested that these differential assimilation rates are important data in planning for technological expansion in Arctic regions. Author

N72-12339*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
ETHIOPIAN TERTIARY DIKE SWARMS
Paul A. Mohr 6 Oct. 1971 93 p refs Sponsored in part by Natl. Geographic Soc.
(Grant NGR-09-015-002)
(NASA-CR-124603; SAO-103-054; SAO-Special-Rept-339) Avail: NTIS CSCL 08G

Mapping of the Ethiopian rift and Afar margins revealed the existence of Tertiary dike swarms. The structural relations of these swarms and the fed lava pile to monoclinal warping of the margins partly reflect a style of continental margin tectonics found in other parts of the world. In Ethiopia, however, conjugate dike trends appear to be unusually strongly developed. Relation of dikes to subsequent margin faulting is ambiguous, and there are instances where the two phenomena are spatially separate and of differing trends. There is no evidence for lateral migration with time of dike injection toward the rift zone. No separate impingement of Red Sea, Gulf of Aden, and African rift system stress fields on the Ethiopian region can be demonstrated from the Tertiary dike swarms. Rather, a single, regional paleostress field existed, suggestive of a focus beneath the central Ethiopian plateau. This stress field was dominated by tension: there is no cogent evidence for shearing along the rift margins. A gentle compression along the rift floor is indicated. A peculiar sympathy of dike hade directions at given localities is evident. Author

N72-12340*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DOES LAMBDA SUB 2,2 VARY?
C. A. Wagner Nov. 1971 22 p refs Submitted for publication
(NASA-TM-X-65775; X-553-71-469) Avail: NTIS CSCL 08G

An attempt has been made to find a secular drift in lambda sub 2,2, or the phase of the low order and degree portion of the geogravity field. This portion may be associated with mass anomalies near the core-mantle boundary. From the geomagnetic evidence, such anomalies might have westward drifts on the order of 0.5 degrees/year. Tracking data on 8 synchronous satellite over a period of 6 years were examined for residual accelerations which might be explained by a drift of the lambda sub 2,2 gravity phase angle. No conclusive movement of lambda sub 2,2 was detected. But a measured upper bound on the drift of less than 0.05 degrees/year is still compatible with possible slow moving irregularities in the region of the core-mantle boundary. Author

N72-12341*# California Univ., Riverside.
STUDIES IN REMOTE SENSING OF SOUTHERN CALIFORNIA AND RELATED ENVIRONMENTS Final Report
Leonard W. Bowden Aug. 1971 21 p
(NASA Order W-12570)
(NASA-CR-124842; USGS-222;) Avail: NTIS CSCL 08G

A summary is presented of the research activities in southern California to determine whether meaningful geographic information was obtainable by use of remote sensing in an area already well documented or if the techniques and methodology could be transferred to related environments. Several broad characteristics of the regional geography were investigated with regards to their feasibility to be studied by aircraft and spacecraft sensors to improve the inventory and understanding of resources and environmental circumstances and to serve as models for future geographic analysis of other regions when using remote sensing devices. Sample activities are described in detail and three experiments producing worthwhile results are highlighted: mapping montane vegetation with color IR imagery, analysis of urban residual environment using color IR aerial photography, and regional agricultural land use mapping tested against color IR photography. Author

N72-12342*# Hittman Associates, Inc., Columbia, Md.
A STUDY OF ENVIRONMENTAL EFFECTS CAUSED BY CESIUM FROM ION THRUSTERS
Mar. 1971 72 p refs
(Contract NAS5-11826)
(NASA-CR-122306; HIT-487; Modification-4) Avail: NTIS CSCL 04A

The ATS-F satellite will carry two cesium ion thrusters. Cesium is a material that is not present in the upper atmosphere, and there is concern that the introduction of this material may result in some unexpected behavior. A study has been conducted to assess the magnitude of the effects that are to be expected. No observable effects were found as a result of the study. Consideration was given to the origin and destination of the material and the various reactions that could occur. The origin was considered to be anywhere in space from altitudes of about 100 km upward. The probable short term destination is in the form of cesium ions trapped in the earth's magnetic field or as ions and atoms in the heterosphere. The maximum possible number of cesium atoms in the field of view of an earth based observer is of the order of one million per square centimeter, far too few to be observable by visible, near-visible, or radio-frequency means. Further, no phenomena could be found that would result in the occurance of an observable event. Author

N72-12343# Environmental Protection Agency, Research Triangle Park, N.C.
A MATHEMATICAL MODEL FOR RELATING AIR QUALITY MEASUREMENTS TO AIR QUALITY STANDARDS
Ralph I. Larsen Nov. 1971 63 p refs
(AP-89) Avail: SOD $0.60

Analysis of air pollution data indicate that air quality measurements tend to fit a general mathematical model having the following characteristics: (1) pollution concentrations are lognormally distributed for all averaging times; (2) medium concentrations are proportional to averaging time raised to an exponent, and (3) maximum concentrations are approximately inversely proportional to averaging time raised to an exponent. The above characteristics have been used to develop equations that may be employed to calculate the geometric mean, standard geometric deviation, maximum concentration, and various percentile concentrations of air pollutions. To illustrate the predictive, as well as the interpretive value of the model, parameters have been first calculated for one averaging time from actual data and then calculated for other averaging times by means of the model. Maximum concentrations calculated with the model are compared with measured values for seven gaseous pollutions obtained during continuous sampling for up to 7 years in eight cities. The analytic techniques described can be used to compare ambient pollutant concentrations with air quality standards and to calculate pollutant parameters for various averaging times. Author

N72-12344# Joint Publications Research Service, Washington, D.C.
MARINE GEOLOGY AND GEOPHYSICS
6 Dec. 1971 811 p refs Transl. into ENGLISH from Morsk. Geol. i Geofiz (Riga), no. 1, 1970 p 3-4 and 193-196
(JPRS-54622) Avail: NTIS HC $9.00/MF $0.95

The accuracy of isoline maps of the anomalous magnetic field is examined on the basis of the magnetic survey process and the compilation and use of the maps. A new calculation of magnetic-survey accuracy, which includes not only the accuracy of field-intensity measurements on survey traverse routes but also the accuracy of interpolating between the traverse routes, is furnished. Errors in interpolating field strength values in the areas between traverse routes and magnetic-coordinate and cartographic-scale errors are discussed. Author

N72-12345# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS Monthly Bulletin, Feb. 1971 [OBSERVATIONS GEOPHYSIQUES BULLETIN MENSUEL, FEVRIER 1971]
1971 28 p In FRENCH and DUTCH Avail: NTIS;

Geophysical data obtained at Dourbes (Belgium) relating to geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during February 1971, are presented. ESRO

N72-12346# National Ocean Survey, Rockville, Md.
ALEUTIAN SEISMIC PROGRAM SEISMOLOGICAL BULLETIN, SEPTEMBER 1970
Feb. 1971 115 p
(Contract AT(29-2)-746)
(CGS-746-111) Avail: NTIS

Preliminary data from an Aleutian network of seismic stations are presented in table form, in order to facilitate current studies of earthquake occurrence in the Aleutian islands. Record arrival times and amplitudes are given. The data were reduced and collated to event hypocenters, and related parameters were derived. Author

N72-12347# National Ocean Survey, Rockville, Md.
ALEUTIAN SEISMIC PROGRAM, SEISMOLOGICAL BULLETIN, JANUARY TO FEBRUARY 1970
Mar. 1971 87 p
(Contract AT(29-2)-746)
(CGS-746-104) Avail: NTIS

Preliminary data acquired from an Aleutian network of seismic stations is distributed in order to facilitate current studies of earthquake occurrence in the Aleutian Islands. Record arrival time and amplitudes are scaled. Final reduction and collation of data to event hypocenters and derivation of related parameters are performed by the seismology division. This compilation is preliminary and is subject to revision on the basis of current research. Author

N72-12348# National Ocean Survey, Rockville, Md.
ALEUTIAN SEISMIC PROGRAM SEISMOLOGICAL BULLETIN, JULY 1970
Feb. 1971 98 p
(Contract AT(29-2)-746)
(CGS-746-109) Avail: NTIS
For abstract, see N72-12347

N72-12349# National Ocean Survey, Rockville, Md.
ALEUTIAN SEISMIC PROGRAM, SEISMOLOGICAL BULLETIN, AUGUST 1970
Feb. 1971 121 p
(Contract AT(29-2)-746)
(CGS-746-110) Avail: NTIS
For abstract, see N72-12345

N72-12350# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
EARTH'S MAGNETIC TAIL OSCILLATIONS
A. I. Ershkovich 1970 35 p refs In RUSSIAN and ENGLISH
(PR-37) Avail: NTIS

The normal modes of the earth magnetic tail, due to the strike over it's lateral surface, were investigated. The results indicate that the excitation of oscillations are connected with the changes of the solar wind velocity vector as well as with the solar wind discontinuities. The tail resembles a beam of magnetic field lines-strings, along which the Alfven waves are propagated. The normal modes of the plasma cylinder, containing the homogeneous magnetic field parallel to the cylinder axis, were also considered. The duration of the magnetic tail normal modes was found to be of several hours, and the total energy reaches approximately 10 to the 22nd power ergs.
Author (ESRO)

N72-12351# Royal Aircraft Establishment, Farnborough (England).
BROADBAND DETERMINATION OF SKY BRIGHTNESS FROM A SKYLARK SOUNDING ROCKET
C. T. Farr Mar. 1971 49 p refs
(RAE-TR-71053) Avail: NTIS

A rocket-borne photometer experiment used to measure sky luminance, at heights above 100 km, is described. The design of a solar shroud to enable these measurements to be made under daylight conditions is outlined, together with the difficulties and precautions associated with this type of experiment. Results obtained during the flight of the photometer are given, and an estimate is made of the overall accuracy of the results obtained.
Author (ESRO)

N72-12352# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
ON THE POSSIBILITY OF THE CHARGED PARTICLES PENETRATION INTO THE MAGNETOSPHERE THROUGH THE NEUTRAL POINTS
E. M. Dubinin and I. M. Podgorny 1971 16 p refs In ENGLISH and RUSSIAN
(D-70) Avail: NTIS

The appearance of fast particles in the magnetosphere can be explained by the fact that the particles are injected into the magnetosphere from a turbulent region through neutral points. This is simulated in the laboratory by injecting fast electrons into a plasma flux which interacts with a magnetic dipole. Three zones of fast particle penetration were discovered in the model experiments. ESRO

N72-12353# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
GEOMAGNETIC TAIL OSCILLATIONS
A. I. Ershkovich 1971 45 p refs In ENGLISH and RUSSIAN
(D-87) Avail: NTIS

By considering the geomagnetic tail as a plasma cylinder immersed in the solar wind, oscillation amplitudes due to solar wind velocity variations were obtained. Kelvin-Helmoltz instabilities were investigated taking into account the influence of the plasma sheet on the tail. It is shown that quasi-periodical events in the magnetosphere display tail oscillations caused by the solar wind. ESRO

N72-12354# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS Monthly Bulletin, Jan. 1971 [OBSERVATIONS GEOPHYSIQUES BULLETIN MENSUEL, JANVIER 1971]
1971 28 p In FRENCH and DUTCH
Avail: NTIS

Geophysical data obtained at Dourbes (Belgium) relating to geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during January 1971, are presented. ESRO

N72-12355# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS Monthly Bulletin, Dec. 1970 [OBSERVATIONS GEOPHYSIQUES BULLETIN MENSUEL, DECEMBRE 1970]
1970 28 p In FRENCH and DUTCH
Avail: NTIS

Geophysical data obtained at Dourbes (Belgium) relating to geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during December 1970 are presented. ESRO

N72-12356# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS Monthly Bulletin, Oct. 1970 [OBSERVATIONS GEOPHYSIQUES BULLETIN MENSUEL, OCTOBRE 1970]
1970 28 p In FRENCH and DUTCH
Avail: NTIS

The geophysical data obtained at Dourbes (Belgium) relative to geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during October 1970 are presented. ESRO

N72-12357# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS Monthly Bulletin, Sep. 1970 [OBSERVATIONS GEOPHYSIQUES BULLETIN MENSUEL, SEPTEMBRE 1970]
1970 28 p In FRENCH and DUTCH
Avail: NTIS

The geophysical data obtained at Dourbes (Belgium) relating to geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during September 1971 are presented. ESRO

N72-12358# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
TURBULENT DISPERSION IN ATMOSPHERIC SHEAR FLOW AND ITS WIND TUNNEL SIMULATION
D. J. Wilson Aug. 1971 68 p refs
(VKI-TN-76) Avail: NTIS

Some methods for the determination of turbulent dispersion of pollution in the atmospheric boundary layer and techniques for the simulation of these dispersion processes in the laboratory are summarized. Experiments in the generation, in a wind tunnel, of an artificially thickened turbulent boundary layer in order to simulate neutral stable atmospheric boundary layers are reported. A boundary layer generated in this way can be used to simulate the lower layers of the atmosphere in existing wind tunnels. ESRO

N72-12359# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, May 1971 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE BULLETIN MENSUEL, MAI 1971]
1971 31 p In FRENCH and DUTCH
Avail: NTIS

Results of ionospheric and cosmic ray (neutron components) observations at Dourbes, Belgium are tabulated from May 1971. ESRO

N72-12360# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, Apr. 1971 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE BULLETIN MENSUEL, AVRIL 1971]
1971 31 p In FRENCH and DUTCH
Avail: NTIS

Results of ionospheric and cosmic ray (neutron component) observations at Dourbes (Belgium) are tabulated for April 1971. ESRO

N72-12361# California Univ., Riverside. Dept. of Geography.
REMOTE SENSING OF CHAPARRAL FIRE POTENTIAL: CASE STUDY IN TOPANGA CANYON, CALIFORNIA
Austin E. Sullivan and William G. Brooner Mar. 1971 53 p refs
(Contract N00014-69-A-0200-5001)
(AD-725862; TR-T-71-1; Task-NR-387-047) Avail: NTIS CSCL 13/12

Urban expansion into areas of chaparral vegetation has greatly increased the danger of wildland fires in settled areas, particularly in southern California. Fires in Topanga Canyon, for example, have been especially severe. Reliable methods of predicting the potential hazard for chaparral fires to man and his settlements in such areas are needed. Aerial photography, using color infrared film, was examined to determine potential fire hazard in Topanga Canyon, and maps indicating potential fire hazard were constructed. A subsequent field survey verified the accuracy of these maps, though the failure to obtain stereoscopic coverage of the study area resulted in a general underestimation of slope as a factor in fire hazard analysis. Remote sensing techniques, especially the use of color infrared aerial photography, provide a useful tool for fire hazard analysis, including interpetive information about fuel volumes, physiognomic plant groupings, the relationships of buildings to both natural and planted vegetation, and fire vulnerability of roofing materials. In addition, the behavior of the September, 1970 Wright Fire in the Topanga study area suggested the validity of the fire potential analysis which had been made prior to that conflagration. Author (GRA)

N72-12362# Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
APPLICATION OF THE TELEGRAPH EQUATION TO OCEANIC DIFFUSION: ANOTHER MATHEMATICAL MODEL
Akira Okubo Mar. 1971 44 p refs
(Contracts N00014-67-A-0163-0006; AT(30-1)-3109; NSF GA-16603; NR Proj. 083-016)
(AD-726178; Ref-71-3; TR-69) Avail: NTIS CSCL 08/3

The solution of the conventional diffusion equation has an obvious shortcoming; that is, the substance concentration will rise instantaneously everywhere when substance is introduced at some point in the sea. Although such instantaneous propagation of substance makes a negligibly small contribution to the concentration at large distances from the source, it might cause serious error in predicting water pollution, microorganism distributions etc. A diffusion equation which overcomes this difficulty is the telegraph equation characterized by a finite propagation velocity. An ad hoc derivation of the telegraph equation from a set of hydromechanical equations identifies the parameters involved in the equation. Thus the propagation velocity is related to the correlation tensor of turbulent velocity. As a result, the one-particle dispersion law by Taylor and the relative diffusion law by Richardson can be deduced from the telegraph equation. Author (GRA)

N72-12363# Notre Dame Univ., Ind. Dept. of Aerospace and Mechanical Engineering
NUMERICAL STUDIES OF CONVECTION CURRENTS AT THE OCEAN'S SURFACE CAUSED BY EVAPORATION, RADIATION AND ATMOSPHERIC COOLING Final Technical Report
Steve A. Piacsek Nov. 1970 81 p refs
(Contract N00014-67-A-0242-0003)
(AD-726185) Avail: NTIS CSCL 08/3

Numerical experiments were performed on convective flows that arise at the ocean's surface undergoing evaporation, long-wave back-radiation and atmospheric cooling. Two specific problems were treated, with greatly different characteristic length scales. To simulate large-scale motions, convection currents have been treated that arise when fluid in a rectangular geometry is rotated with constant angular velocity and cooled with uniform heat flux both from above and below. For Rayleigh number of about 28,000 and Taylor number about 10,000, the time development of the mean-square vorticity components showed

equipartition for circulations in all planes. An examination of the horizontal platforms of motion revealed the existence of a weak, four-lobed jet stream meandering around four centers of strong, closed cyclonic circulations. To simulate small-scale motions, two-dimensional, penetrative thermohaline convection was studied for situations which correspond to evaporative cooling of a stably stratified liquid. Author (GRA)

N72-12364# Naval Postgraduate School, Monterey, Calif.
THE USE OF SURFACE WAVE TECHNIQUES FOR VERIFICATION OF DYNAMIC RIGIDITY MEASUREMENTS IN A KAOLINITE-WATER ARTIFICIAL SEDIMENT M.S. Thesis
William Egan Walsh, Jr. Jun. 1971 43 p refs
(AD-728567) Avail: NTIS CSCL 08/10

A three-dimensional model for the study of surface wave speed measurements in simulated ocean bottom sediments has been constructed using a high-porosity kaolinite-water mixture in a rectangular tank in the laboratory. The propagation of surface waves, assumed to be Rayleigh waves, was studied over the 75 Hz to 300 Hz frequency range using a gated sine wave source and several geophone receivers. Shear wave speeds in the sediment are determined to be 23 m/sec. These measurements are qualitatively compared with measurements made by previous investigators in similar sediments using a torsionally oscillating rod viscoelastometer whose resonant characteristics are sensitive to loading by the sediment in which it is imbedded. Good correlation of results is found with the shear wave speeds calculated from the viscoelastometer data which are in the range of 20 to 30 m/sec. Author (GRA)

N72-12365# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences
SEISMIC SOURCE MECHANISM Annual Report, 1 Jul. 1970 - 30 Jun. 1971
Keiiti Aki and Paul Reasenberg 30 Jul. 1971 68 p refs
(Grant F44620-70-C-0103; ARPA Order 1611; AO Proj. 1611-3)
(AD-728232; AFOSR-71-2203TR; AR-1; Task-62701D) Avail: NTIS CSCL 08/11

The purpose of this project is to develop an instrument system capable of measuring and recording the seismic spectrum at short distances from a large underground explosion. A problem of geologic hazard of considerable interest exists concerning the interaction of explosion-generated shock waves with tectonic stress in the neighborhood of the explosion site. A wide-band measurement of the seismic spectrum at short distances and at various azimuths about the explosion will supply crucial information about the processes in the focal region. The instrument system developed during the period covered by this report is capable of measuring and recording the seismic motions at three locations, separated by up to ten miles. Signal processing, telemetering, and recording are performed by the system. A detailed description of the system and its operation is given. Author (GRA)

N72-12366# Southern Methodist Univ., Dallas, Tex. Dept. of Geological Sciences.
RESEARCH IN ATMOSPHERIC ACOUSTICS Final Scientific Report
Eugene T. Herrin, John A. McDonald, Gordon G. Sorrells, Edward J. Douze, and Zolton A. Der 13 Jul. 1971 173 p refs
(Contract F44620-68-C-0086; AF Proj. AO 1152-5; Proj. 62701d)
(AD-728307; AFOSR-71-2213TR; SMU-80-36) Avail: NTIS CSCL 04/1

The final report consists of eight published papers. They can be grouped under the following headings: (1) An engineering description of the digital system used for acquiring most of the infrasonic and seismic data used in this program; (2) Studies of atmospheric turbulence spectra, acoustic waves from atmospheric disturbances and means of reducing infrasonic noises; (3) The relationships between long seismic noise and atmospheric pressure changes due to turbulence and due to infrasonic waves. Author (GRA)

N72-12367# Naval Research Lab., Washington, D.C.
BISTATIC ACOUSTIC SCATTERING FROM THE OCEAN BOTTOM Interim Report
B. G. Hurdle, K. D. Flowers, and K. p. Thompson 5 Aug. 1971 22 p refs
(RF Proj. 101-03-44-4059; RF Proj. 05-552-40-2; SF Proj. 101-03-15-8181)
(AD-728745; NRL-7285; NRL-501-12; NRL-501-40; Task-4070) Avail: NTIS CSCL 08/10

To obtain the intensity field of sound scattered from a relatively rough region of ocean bottom, pulsed 19.5-kHz transmissions were directed toward the bottom from a ship as it approached and passed a special radio sonobuoy. Sets of data were taken with the beam incident on the bottom at grazing angles between 30 and 90 degrees. Bottom scatter returns in the monostatic direction were received on the source transducer, while reception in other directions was made by the buoy. The source was a tiltable piston transducer with a beamwidth of approximately 8 degrees. The buoy hydrophone was omnidirectional in the horizontal plane with a rejection of surface-reflected signals n the vertical plane. The data were analyzed on the basis of an isotropic-scatter model, taking the velocity gradient into consideration. Polar plots were made of bottom scattering strength. These intensity fields have been obtained from areas east of Bermuda for two bottom types, mud-coral and ooze, in water depths of approximately 750 and 1250 fathoms respectively. The results were compared with geometric reflection and Lambert's scattering law and did not correspond with either or with a combination of both. Author (GRA)

N72-12368# Naval Undersea Research and Development Center, San Diego, Calif. Ocean Sciences Dept.
THERMAL STRUCTURE THROUGH THE CALIFORNIA FRONT: FACTORS AFFECTING UNDERWATER SOUND TRANSMISSION MEASURED WITH A TOWED THERMISTOR CHAIN AND ATTACHED CURRENT METERS Research and Development Report, Sep. 1966 - Apr. 1970
E. C. LaFond and K. G. LaFond Jul. 1971 136 p refs
(SR Proj. 1040301)
(AD-728748; NUC-TP-224; Task-0580) Avail: NTIS CSCL 08/10

The California Front, the boundary region between the Eastern North Pacific Central Water and the Transition Water, is approximately 170 miles wide, and is centered approximately 530 miles off the California Coast. (This region contains large anomalies in water structure that influence sound transmission.) The location of the maximum horizontal change in water properties was established from serial oceanographic stations, and the detail of thermal and current structures was obtained with a towed thermistor chain and attached current meters. The boundary is characterized by stronger than normal horizontal temperature (and salinity) gradients; large vertical changes in isotherm depths; temperature inversions; a large surface temperature gradient; and a thermocline separation. Temperature inversions produce sound channels above the level of increased temperature. Measured current shear shows relative current in the upper layers to be in a southerly direction on the eastern side of the boundary and in a westerly direction on the western side; however, current shear inside the boundary regions was in diverse directions. Author (GRA)

N72-12369# Naval Postgraduate School, Monterey, Calif.
USE OF CORRELATION TECHNIQUES IN AUTOMATIC DETECTION OF THERMAL PLUMES IN THE AIR LAYER ADJACENT TO NATURAL WATER WAVES M.S. Thesis
Stanley Ernest Sokol Jun. 1971 41 p refs
(AD-728680) Avail: NTIS CSCL 04/1

Pattern recognition of temperature fluctuations, representing plumes, occurring in data recorded in the atmospheric boundary

layer was performed utilizing predefined characteristics of these phenomena. An averaged, normalized plume was computed based on the characteristics of ten previously identified plumes. This standard plume consisted of two components or curves and a component-by-component correlation was made of this standard plume with various data sets, each set containing temperature information recorded at two different heights. A product curve was then formed from the two correlation curves and used to identify plumes automatically. A plume was said to have been detected if the product curve exceeded a previously selected threshold. The accuracy of this detection method was determined by visual inspection of the same records by a meteorologist. Approximately 73 per cent of all plume occurrences in the data sets were detected which indicates the appropriateness of this method of pattern recognition for plume detection.

Author (GRA)

N72-12400*# Geological Survey, Washington, D.C.
GEOLOGICAL STUDIES OF YELLOWSTONE NATIONAL PARK IMAGERY USING AN ELECTRONIC IMAGE ENHANCEMENT SYSTEM
Harry W. Smedes *In* Philco-Ford Corp. Sci. Study Utilizing Philco-Ford Electron. Enhancement Viewer 30 Jun. 1971 18 p (See N72-12394 03-14)
Avail: NTIS CSCL 14E

N72-12401*# Bureau of Mines, Washington, D.C.
OPEN-PIT MINING EVALUATION: IMAGE ENHANCEMENT (TWIN BUTTES OPEN-PIT COPPER MINE), TUCSON, ARIZONA
William C. Henkes *In* Philco-Ford Corp. Sci. Study Utilizing Philco-Ford Electron. Enhancement Viewer 30 Jun. 1971 7 p (See N72-12394 03-14)
Avail: NTIS CSCL 14E

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N72-12370* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APOLLO 14 LUNAR PHOTOGRAPHY. PART 1: DATA USERS' NOTE
Arthur T. Anderson Aug. 1971 30 p refs
(NASA-TM-X-67456; NSSDC-ID-71-008a-01; NSSDC-71-16a-Pt-1) Avail: NASA. Goddard Space Flight Center, Greenbelt, Md. SSDC CSCL 14E

This note announces the availability of Apollo 14 pictorial data and acts as an aid to investigators in the selection of photographs for study. Guidance is also provided for the interpretation of photographs. As background information, brief descriptions of the Apollo 14 mission objectives, photographic equipment, and photographic coverage and quality are provided.

Author

N72-12371* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO 14 PHOTOGRAPHY 70-mm, 35-mm, 16-mm, AND 5-INCH FRAME INDEX, PART 2
Arthur T. Anderson Greenbelt, Md. NASA. Goddard Space Flight Center Aug. 1971 143 p
(NASA-TM-X-67455; NSSDC-71-16b-Pt-2) Avail: NASA. Goddard Space Flight Center, Greenbelt, Md. SSDC CSCL 14E

For each 70-mm and usable 5-in. frame, the index presents the information available on: (1) the revolution number; (2) the focal length of the camera; (3) the photo scale at the principal point of the frame; (4) the selenographic coordinates at the principal point of the frame; (5) the approximate tilt of the photo; (6) the percentage of forward overlap of the frame; (7) the sun angle; (8) the quality of the photography; and (9) the photo index area (using the Lunar Aeronautical Chart system for the earthside and similar breakdowns on the farside region). A brief description of each frame is also included. The index to the 35-mm stereo frames is listed by frame number and general description. The index to the 16-mm sequence photography includes information concerning the approximate surface coverage of the photographic sequence and a brief description of the principal features shown. A remarks column is included to indicate; (1) if the sequence is plotted on the photographic index map, and (2) the quality of the photography. Directly following the indexes are two Photo Index Area Location Diagrams, one for the lunar earthside and one for the lunar farside.

Author

N72-12372* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO 14 PHOTOGRAPHIC CATALOG, PART 3
Arthur T. Anderson Greenbelt, Md. NASA. Goddard Space Flight Center Aug. 1971 380 p
(NASA-TM-X-67391; NSSDC-71-16c-Pt-3) Avail: NASA. Goddard Space Flight Center, Greenbelt, Md. SSDC CSCL 14E

Proof prints of 70-mm and 5-in. photographs taken during the Apollo 14 mission are presented along with uncontrolled mosaics of surface panoramas and continuous orbital photography. This catalog is designed to be used in conjunction with the sections on 70-mm and 5-in. photography in Part 2, the Apollo 14 photography indexes, of this Apollo 14 data package. The information in Part 2 makes it possible to locate the area covered by each frame.

Author

N72-12373# Bayerische Akademie der Wissenschaften, Munich (West Germany).
CONTOURS FROM PHOTOGRAMMETRIC MEASURED GROUND PROFILES AND THEIR USEFULNESS FOR THE 1:5000 SCALE MAP Ph.D. Thesis [HOEHENLINIEN AUS PHOTOGRAMMETRISCH GEMESSENEN GELAENDEPROFILEN UND IHRE BRAUCHBARKEIT FUER DEN KARTENMASSSTAB 1:5000]
Heinz Schmidt-Falkenberg 1970 160 p refs In GERMAN
Avail: NTIS

Topographic contour lines are obtained from photogrammetric determined terrain profiles by scanning and transferring stereo planigraphic measurements from the stereo model to the cartographic surface layer on a glass plate. Terrain surface representation by photogrammetric profile measurements is most accurate when profile distances are kept small. Transl. by G.G.

N72-12374# National Engineering Lab., Glasgow (Scotland). Properties of Fluids and basic heat Transfer Div.
THE MEASUREMENT OF GAS VISCOSITY BY A VIBRATING WIRE TECHNIQUE
J. T. R. Watson Dec. 1970 18 p refs
(NEL-473) Avail: NTIS

Apparatus for measuring the viscosity of gases and mixtures of gases has been designed to fulfill the need for data over a range of conditions, accurate enough for most industrial requirements. The viscometer is based upon the damping of the transverse oscillations of a taut wire in a fluid, the rate at which the oscillations decay being used to determine the viscosity of the fluid. This is a technique first developed for the measurement of the viscosity of liquid helium. A solution to the hydrodynamic problem was indicated based on pendulums and shown to hold for a wide range of parameters. The measurements on liquid helium were in good agreement with the available data; the results showed a mean scatter of some 2 percent.

Author

N72-12375*# Raytheon Co., Sudbury, Mass. Equipment Div.
REMOTE DETECTION OF TRAILING VORTICES, TASK 3, MODIFICATION 3 Final Report
J. Fridman, C. Harris, A. Jelalian, W. Keene, K. Meister, C. Miller, and C. Sonnenschein 17 Jun. 1971 29 p
(Contract NAS8-30512)
(NASA-CR-121034; ER71-4233) Avail: NTIS CSCL 14B

The operation of a frequency tracker for use with the laser Doppler velocimeter (LDV) is reported. Topics discussed include: laser beam profile, lens matching and LDV resolution data. It is concluded that the LDV provides good ground wind signals. The loss in sensitivity of the cavity system at high frequencies is partly compensated by an increase in the scattering cross section of the atmosphere due to dust. F.O.S.

N72-12376# Maryland Univ., College Park. Astronomy Program.
FABRY-PEROT REDUCTION PROGRAMS
R. Brent Tully Oct. 1971 142 p
Avail: NTIS

An analysis of the Fabry-Perot interferogram as a function of velocity is presented. Data cover machine reduction, image tube distortion and correction analysis, and microdensitometer reduction programs. Computer programs, subroutines, input-output routines, and flow diagrams are also given. E.H.W.

N72-12377# Maryland Univ., College Park. Dept. of Physics and Astronomy.
THE MARYLAND PHOTOGRAPHIC FABRY-PEROT INTERFEROMETER
R. Brent Tully [1971] 23 p Submitted for publication
(TR-70-091) Avail: NTIS

Guidelines to the operation of a Fabry-Perot interferometer are given. Calibration procedures along with data on the effects of pressure and temperature are included. Data also cover the image tube, optical system, guide mechanism, and collimation. E.H.W.

N72-12378*# Exotech, Inc., Gaithersburg, Md.
DESIGN, DEVELOPMENT AND FABRICATION OF A SOLAR EXPERIMENT ALIGNMENT SENSOR (SEAS) Final Report
J. R. Bancroft, M. Z. Fain, and D. F. Johnson Apr. 1971 104 p refs
(Contract NAS2-4835)
(NASA-CR-73349; Tr-IC039) Avail: NTIS CSCL 14B

The design, development and testing of a laboratory SEAS (Solar Experiment Alignment Sensor) system are presented. The system is capable of overcoming traditional alignment and calibration problems to permit pointing anywhere on the solar disc to an accuracy of five arc seconds. The concept, development and laboratory testing phases of the program are discussed, and particular attention has been given to specific problems associated with selection of materials, and components. The conclusions summarize performance capability and discuss areas for further study including the effects of solar limb darkening and effects of annual variations in the apparent solar diameter. Author

N72-12379*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TWO NEW METHODS TO INCREASE THE CONTRAST OF TRACK-ETCH NEUTRON RADIOGRAPHS
James Morley [1971] 17 p refs Proposed for presentation at the 18th Ann. Meeting of the Am. Nucl. Soc., Las Vegas, 18-22 Jun. 1972
(NASA-TM-X-67947; E-6366) Avail: NTIS CSCL 18D

Methods for increasing the (optical density span) of radiographs were evaluated. In one method, fluorescent dye was deposited in the tracks of the radiograph. The radiograph was then examined under ultraviolet light. The second method was a crossed Polaroid filter technique. The radiograph was placed between the filters and then illuminated with a diffuse white-light source. An increase in the optical density span from .10 to .37 was obtained with the dye method. With the Polaroid method, the increase obtained was from .10 to 2.4. Author

N72-12380*# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research.
A SEARCH FOR LIFE ON EARTH AT 100 METER RESOLUTION
Carl Sagan and David Wallace Jun. 1970 58 p refs Prepared for JPL
(Grant NGR-33-010-101; JPL-952487)
(NASA-CR-124643; CRSR-451) Avail: NTIS CSCL 14E

A study of several thousand photos indicated approximately 1% of Gemini and Apollo photographs of the earth at 100 m resolution revealed signs of life; rectangular arrays due to human agricultural and urban territoriality, roads, canals, jet contrails, and industrial pollution. Potential false positives such as dunes, sand bars, and jet stream clouds abound. A curve was derived for the detectivity of contemporary life on earth, in a plot of ground resolution versus global coverage. A comparable biology on Mars would not have been detected by all observations of Mars through Mariner 7. Forthcoming Mars orbiter and lander imaging experiments hold significant promise of detecting life on Mars of contemporary terrestrial extent and advancement, should such life exist. Author

N72-12381# Kiruna Geophysical Observatory (Sweden).
EQUIPMENT FOR MAGNETOTELLURIC MEASUREMENTS IN THE FREQUENCY RANGE 0.01 HZ TO 10 KHZ
S. Westerlund and H. Johansson Sep. 1971 38 p refs
(KGO-713) Avail: NTIS

The equipment used for magnetotelluric measurements in the frequency range 0.01 Hz to 10 kHz is described. Two components of the magnetic field are measured with magnetometer or loops and two components of the electric field with electrodes inserted into the ground. The design of filters and amplifiers, through which the signals pass before they are recorded on magnetic tape is discussed as well as their performance during measurement. Since the measurements are absolute measurements, quite much space is devoted to the calibration procedure. Author

N72-12382*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A FIXED BIAS, FLOATING DOUBLE PROBE TECHNIQUE WITH SIMPLE LANGMUIR PROBE CHARACTERISTICS
Edward P. Szuszczewicz Nov. 1971 30 p refs Submitted for publication
(NASA-TM-X-65768; X-625-71-450) Avail: NTIS CSCL 14B

A new floating double-probe method is presented which has advantages over other floated-probe systems previously described in literature. The method utilized two electrodes, one of constant area and the other with a variable area. The two-electrode configuration is separated by a fixed bias voltage. The current-voltage characteristics of the new technique, which are generated by varying the area of the one electrode, are identical to those of a simple Langmuir probe, thus coupling all the advantages of a floated-probe system with the simple analysis scheme generally applied to the Langmuir probe for the determination of plasma density and temperature. Author

N72-12383*# Scientific Translation Service, Santa Barbara, Calif.
ON LIGHTNING PROTECTION WITH A REMOTE LIGHTNING ROD
B. Walter Washington NASA Dec. 1971 19 p refs Transl. into ENGLISH from Z. Tech. Phys. (Leipzig),
(Contract NASw-2035)
(NASA-TT-F-14065) Avail: NTIS CSCL 14B

Disadvantages of the present type of lightning protection are discussed. It is concluded from tests and lightning statistics that lightning rods which are separate from the building to be protected offer the best protection. Author

N72-12384*# Techtran Corp., Glen Burnie, Md.
COMPUTATION OF THE WIDEBAND MICHELSON INTERFEROMETER FOR FAR INFRARED RADIATION
V. M. Charugin and G. B. Sholomitskiy Washington NASA Aug. 1971 10 p refs Transl. into ENGLISH of Acad. of Sci. USSR, Inst. for Space Res., Moscow, report Pr-63, "Raschet shirokopolosnogo svetosilnogo interferometra maykelsona dlya salney infrakrasnoy oblasti spektra" 1971, 12 p
(Contract NASw-2037)
(NASA-TT-F-13764; Pr-63) Avail: NTIS CSCL 14B

Computations are presented to show how the proposed interferometer is expected to surpass ones of monochromator type in measuring and distinguishing the spectra of faint radiation sources. Author

N72-12385*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
TRACKING VARIATIONS IN THE ALPHA ACTIVITY IN AN ELECTROENCEPHALOGRAM
K. S. Prabhu Oct. 1971 29 p refs
(Grant NGL-22-007-143)
(NASA-CR-124543; TR-4) Avail: NTIS CSCL 06B

The problem of tracking Alpha voltage variations in an electroencephalogram is discussed. This problem is important in encephalographic studies of sleep and effects of different stimuli on the brain. Very often the Alpha voltage is tracked by passing the EEG signal through a bandpass filter centered at the Alpha frequency, which hopefully will filter out unwanted noise from the Alpha activity. Some alternative digital techniques are suggested and their performance is compared with the standard technique. These digital techniques can be used in an environment where an electroencephalograph is interfaced with a small digital computer via an A/D convertor. They have the advantage that statistical statements about their variability can sometimes be made so that the effect sought can be assessed correctly in the presence of random fluctuations. Author

N72-12386*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEVELOPMENT AND TESTING OF THE TELEVISION INSTRUMENT FOR THE MARINER MARS 1971 SPACECRAFT
1 Nov. 1971 30 p refs
(Contract NAS7-100)
(NASA-CR-124575; JPL-TM-33-505) Avail: NTIS CSCL 14E

The Mariner Mars 1971 television instrument is described. It emphasizes those aspects that are different from the Mariner Mars 1969 television subsystem. The various modes of operation are described and functional descriptions of the major elements in the system summarized. An electronic description of the circuits that differ from those of Mariner Mars 1969 is also presented along with a brief description of the calibration and test sequences. Author

N72-12387*# Honeywell, Inc., Lexington, Mass. Radiation Center.
DESIGN AND DEVELOPMENT OF SOLID STATE DETECTOR FOR SCADS Final Technical Report
Oct. 1971 82 p
(Contract NAS5-11270)
(NASA-CR-122302) Avail: NTIS CSCL 18D

Solid state detector technology was applied to the fabrication and testing of cadmium sulfide and silicon narrow slit detector/preamplifier subassemblies. Fabrication of the silicon detector and the cadmium sulfide detectors was accomplished by utilizing cadmium sulfide cells and silicon cells. Fabrication of the preamplifiers for both silicon and cadmium sulfide slit type detectors was also carried out. The design of these preamplifiers was adjusted to ascertain that the limiting noise source of the detector/preamplifier subassembly is the detector and the input cable. Author

N72-12388# National Bureau of Standards, Washington, D.C.
PRESSURE TYPE LIQUID LEVEL GAGES
R. M. Schoonover and J. F. Houser [1971] 30 p Sponsored in part by AEC
(NBS-10396) Avail: NTIS

The design and operation of a pressure-type liquid level gage are discussed. Procedures for calibrating the gage using an 800-gallon tank with water are described, and the results are presented. NSA

N72-12389# Laboratoire Central de l'Armement, Arcueil (France).
AUTOMATIC ANALYSIS OF GAMMA SPECTRA WITH A JUNCTION DETECTOR
Jacques Vesque 28 Oct. 1970 62 p refs In FRENCH
(NP-18877) Avail: AEC Depository Libraries

A method for computer analysis of gamma spectra obtained with Ge(Li) junction detectors is presented. The program is described in detail. Author (NSA)

N72-12390# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
EQUIPMENT FOR REMOTE CONTROL OF GAMMA SCANNING IN A HOT CELL
C. Cochi and L. Babiloni 8 Jan. 1971 22 p refs In ITALIAN
(RT/ING-(71)1) Avail: AEC Depository Libraries

Electronic equipment for the remote control of an in-cell system is described. The apparatus was designed to produce a longitudinal and rotating continuous, or stepping, motion that permits power distribution determination in cylindrical fuel rods of high or low gamma activity by scanning. A brief description of the gamma-scanning technique is also included. Author (NSA)

N72-12391# Royal Aircraft Establishment, Farnborough (England). Avionics Dept.
THE DRIFT OF AN AUTO-PILOT GYROSCOPE DUE TO PROLONGED ACCELERATION IN THE SKYLARK ROCKET (ABRIDGED VERSION)
E. R. Knott London Aeron. Res. Council 1971 65 p refs Supersedes RAE-TR-68231; ARC-31067
(ARC-CP-1147; RAE-TR-68231; ARC-31067) Avail: NTIS; HMSO: 85p; PHI: $3.55

Rocket attitude obtained from the gyroscopes under test is compared with rocket attitude determined from other instrumentation systems to obtain gyro-drift. The principal reference system used to determine missile attitude is provided by three radio-interferometers fitted to the rocket. A secondary reference system comprises an aerial-survey camera which is installed in the vehicle and used to photograph ground markers. The instrumentation was developed and flown in a series of Skylark rockets. The program of firings is summarized and the accuracy of the instrumentation systems assessed. Ground equipment used to carry out pre-flight drift measurements on the gyroscopes is briefly described. Typical gyro-drift data obtained from flight are given, together with conclusions based on data from twelve gyroscopes tested during the program.
Author (ESRO)

N72-12392# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
LOW-SPEED WIND-TUNNEL CALIBRATIONS OF THE PITOT AND STATIC PRESSURE SENSORS AND WIND VANES ON THE SHORT SC AIRCRAFT
K. P. King and E. N. Rowthorn London Aeron. Res. Council 1971 32 p refs supersedes RAE-TR-70133; ARC-32780
(ARC-CP-1162; RAE-TR-70133; ARC-32780) Avail: NTIS; HMSO: 45p; PHI: $1.95

The pressure sensors tested consisted of a perforated sphere static, a twin venturi pitot arrangement, designed to permit the derivation of dynamic pressure in both forward and backward flight, and a Mk.8T pitot-static head. It was found that only the Mk.8T pitot-static head gave satisfactory results over the range of sideslip angles likely to be met in flight. This

pitot-static head was then calibrated over a range of incidence and sideslip angles and error contours were plotted to facilitate the correction of the indicated static and dynamic pressures recorded in flight. The wind vanes measuring sideslip and incidence were also calibrated over the same range and error contours plotted for the correction of their indications. Finally the dynamic response of the wind vanes was investigated to determine their natural frequency and damping and hence their amplitude ratio and phase lag when recording aircraft oscillations. Author (ESRO)

N72-12393# Quality Assurance Directorate (Materials), London (England).
A VERSATILE MICROPHOTOMETRY SYSTEM
R. A. Mostyn, E. I. Locke, and R. V. Jury Jun. 1970 16 p refs
(QAD-MATS-168) Avail: NTIS

The system consists of a Hilger nonrecording microphotometer fitted with a two-speed motor drive and the standard photomultiplier detector conversion, to which two alternative read-out modes are attached. A digital voltmeter, optionally feeding a strip printer, provides a rapid high precision system for routine emission spectrography. A potentiometric recorder, brought into operation by a change-over switch, provides a permanent record of measurements, also with good precision, particularly for applications in which spectral interferences, structure etc. are of importance. Author (ESRO)

N72-12394*# Philco-Ford Corp., Palo Alto, Calif. Western Development Labs. Div.
SCIENTIFIC STUDY UTILIZING PHILCO-FORD ELECTRONIC ENHANCEMENT VIEWER Final report, Oct. 1969 - Jun. 1971
30 Jun. 1971 134 p refs Sponsored by NASA Original contains color illustrations
(Contract N62306-70-C-0200)
(NASA-CR-123481; AD-726757; WDL-TR-4498) Avail: NTIS CSCL 14E

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N72-12395*# Philco-Ford Corp., Palo Alto, Calif.
VIDEO ENHANCEMENT: PRINCIPLES AND TECHNIQUES. VIDEO COLOR ENHANCEMENT VIEWER
In its Sci. Study Utilizing Philco-Ford Electron. Enhancement Viewer 30 Jun. 1971 9 p (See N72-12394 03-14)
Avail: NTIS CSCL 14E

The electronic image enhancement technique which scans the small density variations in a transparency, greatly amplifies them, and converts them from analog form to a 16-step digital form, is discussed. Contrasting false-colors are arbitrarily assigned to each of the 16 steps to clearly distinguish the successive density steps from one another. Enhancement and manipulation is accomplished electronically and the enhanced subject is then displayed on a TV monitor for study. This process is also applicable to color transparencies. Color-separation filters are employed to separate the red, green, and blue bands. Each color record contains its associated spectral information and each is a subject for enhancement. Combinations of two or more spectral bands can be added to or subtracted from each other photographically to enhance desired, or suppress unwanted, information. Author

N72-12396*# Philco-Ford Corp., Palo Alto, Calif. Forestry Remote Sensing Lab.
ADDITIVE COLOR IMAGE ENHANCEMENT TECHNIQUES AND EQUIPMENT
Jerry D. Lent *In* Philco-Ford Corp. Sci. Study Utilizing Philco-Ford Electron. Enhancement Viewer 30 Jun. 1971 12 p (See N72-12394 03-14)
Avail: NTIS CSCL 14E

Enhancement techniques and equipment used in the evaluation of the Apollo 9 flight SO65 photography are discussed. The potential usefulness of such techniques to inventory the earth's resources are indicated. The purpose of any form of image enhancement usually is two-fold: (1) to increase the total amount of information that is derivable from the raw data; and (2) to facilitate the data extraction process. When additive color image enhancement techniques are employed, these objectives are usually realized by highlighting subleties in image tones. Such enhancements can be accomplished by either optical or electronic means. Author

N72-12397*# California Univ., Santa Barbara.
A COMPARISON OF ENHANCEMENT VIEWERS
John E. Estes *In* Philco-Ford Corp. Sci. Study Utilizing Philco-Ford Electron. Enhancement Viewer 30 Jun. 1971 27 p Prepared in cooperation with Kansas Univ., Lawrence (See N72-12394 03-14)
Avail: NTIS CSCL 14E

The capabilities of electronic processors such as an electronic multiimage processor, an enhancement viewer, an optical combiner (FRSL), the CIRID (a combined interpretation of color and infrared Ektachrome), and imagery obtained by photographic systems are discussed. In order to evaluate the enhancement methods, statistical information was gained from an aggregate sample of 45 users. The time and accuracy information was used as raw data for a specifically designed computer program. Rankings of the imagery methods were made in terms of correct responses, fewest commission errors, least time, and lowest total by individual categories. The results can be interpreted in a variety of ways. The results from each major experimental imagery category were summarized and an overall ranking summary was also provided. Author

N72-12398*# California Univ., Berkeley. Forestry Remote Sensing Lab.
APOLLO 9 SCIENTIFIC EXPERIMENT NO. 065
R. N. Colwell *In* Philco-Ford Corp. Sci. Study Utilizing Philco-Ford Electron. Enhancement Viewer 30 Jun. 1971 33 p refs Sponsored by NASA, Dept. of Agr., Dept. of Interior, Naval Oceanog. Office et al (See N72-12394 03-14)
(Expt-S065-Apollo-9) Avail: NTIS CSCL 14E

Capabilities for the inventory of various kinds of earth

resources using spaceborne remote sensors are discussed. The Apollo 9 mission experiment S065 is described. A comparison of photography used during the Apollo 9 flight and supporting photography obtained simultaneously from high flying aircraft is presented. Analyses of resources in California and Arizona are reported. Author

N72-12399*# Miami Univ., Coral Gables, Fla.
USE OF ENHANCEMENT EQUIPMENT ON AERIAL PHOTOGRAPHY OF GARDEN AND BUSH KEYS IN THE DRY TORTUGAS, FLORIDA
Howard J. Teas *In* Philco-Ford Corp. Sci. Study Utilizing Philco-Ford Electron. Enhancement Viewer 30 Jun. 1971 11 p (See N72-12394 03-14)
Avail: NTIS CSCL 14E

The feasibility of using image enhancement equipment to analyze vegetation is discussed. The area covered is Garden and Bush Keys in the Dry Tortugas island group. Photographs of the vegetation taken during aerial reconnaissance are provided. It is concluded that image enhancement equipment provides adequate identification of foliage and vegetation in the Florida Keys area. Author

N72-12400*# Geological Survey, Washington, D.C.
GEOLOGICAL STUDIES OF YELLOWSTONE NATIONAL PARK IMAGERY USING AN ELECTRONIC IMAGE ENHANCEMENT SYSTEM c13
Harry W. Smedes *In* Philco-Ford Corp. Sci. Study Utilizing Philco-Ford Electron. Enhancement Viewer 30 Jun. 1971 18 p (See N72-12394 03-14)
Avail: NTIS CSCL 14E

Geological studies of the Yellowstone National Park using an electronic image enhancement system are presented. The types of remote sensors used were: (1) black and white multiband, (2) color photography, (3) color infrared, (4) thermal infrared, and side-looking K band radar. Color separation negatives were made from color prints of transparencies by successively photographing the color print on black and white film using red, green, and blue filters. The three separation negatives collectively contain all the color information contained in the original color image. Author

N72-12401*# Bureau of Mines, Washington, D.C.
OPEN-PIT MINING EVALUATION: IMAGE ENHANCEMENT (TWIN BUTTES OPEN-PIT COPPER MINE), TUCSON, ARIZONA c13
William C. Henkes *In* Philco-Ford Corp. Sci. Study Utilizing Philco-Ford Electron. Enhancement Viewer 30 Jun. 1971 7 p (See N72-12394 03-14)
Avail: NTIS CSCL 14E

Experiments with color video enhancement systems and micro-densitometers to obtain sharper definition of an open pit copper mine's features are discussed. The electronic image enhancement system is capable of simultaneously scanning two transparencies and displaying combinations of processed and unprocessed signals from two spectral bands on a television monitor. It is concluded that the time-features were enhanced by the electronic equipment employed, but that imagery, suitable for aerial measurement, seems to be dependent on the operator's experience with the system and prior knowledge of the area or object being examined. Author

N72-12402*# Stanford Univ., Calif.
OBSERVATION OF FINER DETAIL IN COLD SPRING FLOW PATTERNS ACROSS MONO LAKE (CALIFORNIA) USING AN INFRARED IMAGE
J. P. Lyon and Keenan Lee *In* Philco-Ford Corp. Sci. Study Utilizing Philco-Ford Electron. Enhancement Viewer 30 Jun. 1971 4 p (See N72-12394 03-14)
Avail: NTIS CSCL 14E

A two-color video-display densitometer was found useful for the qualitative examination of temperature distribution patterns on infrared imagery. On positive imagery the film density is proportional to temperature, so any variation in density provides temperature information. One particularly useful application of the false-color densitometer was to trace water discharge patterns offshore from shoreline springs. On some infrared imagery, the patterns of spring water are rather complex because individual spring discharges coalesce with other spring water offshore, and the eye cannot distinguish between the subtle grey density changes. By projecting the imagery on the video screen and overprinting a single density slice, which is then varied, the discharge from any one spring can be made to move out from the shore and its actual flow path followed from the shoreline into the complex water patterns. Author

N72-12403*# Virginia Univ., Charlottesville. Dept. of Environmental Science.
AERIAL PHOTOGRAPHIC STUDIES OF THE COASTAL WATERS OF NEW YORK AND LONG ISLAND
Mahlon G. Kelly *In* Philco-Ford Corp. Sci. Study Utilizing Philco-Ford Electron. Enhancement Viewer 30 Jun. 1971 7 p (See N72-12394 03-14)
Avail: NTIS CSCL 14E

Aerial and satellite photographs show significant patterns of distribution of coastal bottom (benthic) vegetation and suspended materials in the water. A knowledge of these distributions, which are impossible to perceive from the surface, is obviously an important factor to understand coastal ecological processes and to aid in future planning. Benthic vegetation, as seen from the air, is a good indicator of environmental conditions in tropical clear-water areas. Work is being extended to temperate turbid waters. Water color patterns caused by backscattered light from suspended materials are related to oceanographic conditions such as water mass boundaries, chlorophyll concentration, phytoplankton populations, suspended sediments, and the effect of man's sewage and dredging. Author

N72-12404# Naval Air Development Center, Johnsville, Pa. Aero Materials Dept.
A PERFORMANCE EVALUATION OF THE HONEYWELL RF PROBE
G. K. McConnell 18 Jun. 1971 13 p
(AD-726179; NADC-MA-7108) Avail: NTIS CSCL 14/2

The Honeywell R. F. (Radio Frequency) Probe has been applied to malfunctioning equipment by electronics specialists, and laboratory tests have been performed on circuits containing simulated defects. The study indicated that the Probe would be a valuable addition to the standard instrumentation of most electronic or electrical maintenance and repair activities.
Author (GRA)

N72-12405# Naval Postgraduate School, Monterey, Calif.
THE DESIGN AND EVALUATION OF A MICROWAVE PHASE MEASUREMENT SYSTEM Ph.D. Thesis
William Alan Weis Jun. 1971 40 p refs
(AD-728722) Avail: NTIS CSCL 14/2

The thesis was undertaken to ascertain the feasibility of producing an accurate phase measurement system using standard components normally available in the laboratory or those that could be purchased relatively inexpensively. Several systems are discussed and two of them were physically evaluated. It was concluded that it was not feasible to build an accurate system without large additional expense; however, if such expense is justifiable recommendations are given for the construction of an improved system. Author (GRA)

N72-12286*# Michigan Univ., Ann Arbor. Willow Run Labs.
SUMMARY OF MICHIGAN MULTISPECTRAL INVESTIGATIONS PROGRAM
Richard R. Legault *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 31 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 14B

N72-12288*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
THE APPLICATION OF AUTOMATIC RECOGNITION TECHNIQUES IN THE APOLLO 9 SO-65 EXPERIMENT
R. B. MacDonald *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 17 p (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 14E

N72-12289*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
THE DEVELOPMENT OF MACHINE TECHNOLOGY PROCESSING FOR EARTH RESOURCE SURVEY
D. A. Landgrebe *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 31 p refs (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 14E

N72-12293*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex. Earth Observation Div.
RESULTS OF SCATTEROMETER SYSTEMS ANALYSIS FOR NASA/MSC EARTH OBSERVATION SENSOR EVALUATION PROGRAM
K. Krishen, N. Vlahos, O. Brandt, and G. Graybeal *In* Its 3d Ann. Earth Resources Program Rev., Vol. 2 1970 50 p refs Prepared in cooperation with Lockheed Electronics Co., Houston, Tex. (See N72-12269 03-13)
Avail: NTIS HC $9.00/MF $0.95 CSCL 14B

N72-12299*# Geological Survey, Tucson, Ariz.
MEASUREMENT OF PLANT COMMUNITY COVER FROM AERIAL PHOTOGRAPHS USING EKTACHROME INFRARED AERO FILM
Raymond M. Turner *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 8 p refs Sponsored by NASA (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

N72-12308*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
REMOTE SENSING OF OCEAN COLOR FROM AIRCRAFT
G. L. Clarke and G. C. Ewing *In its* 3d Ann. Earth Resources Program Rev., Vol. 3 1970 12 p refs (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

N72-12312*# TRW Systems Group, Redondo Beach, Calif.
VISIBLE REGION REMOTE SPECTROSCOPY OF POLLUTED WATER
Peter G. White *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 15 p (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

N72-12318*# Naval Research Lab., Washington, D.C. E. O. Hulburt Center for Space Research.
PASSIVE MICROWAVE STUDIES
James P. Hollinger *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 14 p refs (See N72-12295 03-13)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

N72-12633# Centre National d'Etudes Spatiales, Bretigny-Sur-Orge (France).
REPORT OF CNES ACTIVITIES IN THE FIELD OF INSTRUMENTATION [PRESENTATION DES ACTIVITES DU CNES DANS LE DOMAINE DE L'INSTRUMENTATION]
P. Rousseau *In its* 2nd symp. on optics 1969 p 1-10 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

N72-12634# Societe d'Etudes et d'Application de Vide Optique et Mecanique, Argenteuil (France).
STUDY AND FABRICATION OF THIN FILMS FOR THE FAR ULTRAVIOLET BETWEEN 1200 AND 2500 A [ETUDE ET FABRICATION DE COUCHES MINCES POUR L'ULTRAVIOLET LOINTAIN DE 1200 A 2500 A]
A. Malherbe *In* CNES 2nd Symp. on Optics 1969 p 11-20 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

N72-12639# Compagnie Francaise Thomson Houston-Hotchkiss Brandt, Paris.
IMAGE INTENSIFIER TUBES: SUPER VIDICON [LES TUBES DE PRISES DE VUES A INTENSIFICATION D'IMAGE: LE SUPER VIDICON]
M. Blamoutier *In* CNES 2nd Symp. on Optics 1969 p 60-58 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

N72-12640# Paris Observatory, Meudon (France).
ELECTRONIC CAMERA FOR SPACE RESEARCH [CAMERA ELECTRONIQUE POUR LA RECHERCHE SPATIALE]
Jean Guerin *In* CNES 2nd Symp. on Optics 1969 p 69-75 refs In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

N72-12642# Compagnie des Compteurs, Montrouge (France).
A NEW THERMOPILE DETECTOR FOR USE IN AN INFRARED HORIZON SCANNER FOR SYNCHRONOUS SATELLITES [NOUVEAU DETECTEUR DU SENSEUR D'HORIZON INFRAROUGE A THERMOPILE POUR LES SATELLITES GEO-STATIONNAIRES]
V. Volkovisky *In* CNES 2nd Symp. on Optics 1969 p 84-113 ref In FRENCH (See N72-12632 03-23) Avail: NTIS HC $6.00/MF $0.95

N72-12643# Laboratoires d'Electronique et de Physique Appliquee, Limeil-Brevannes (France).
HORIZON SCANNERS [SENSEURS D'HORIZON]
F. Desvignes *In* CNES 2nd Symp. on Optics 1969 p 114-127 In FRENCH Sponsored in part by CNES, Lab. de Rech. Balistiques et Aerodyn. and ESRO (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

N72-12644# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
SYSTEM FOR MEASURING INFRARED RADIATION BY MEANS OF A PNEUMATIC DETECTOR FOR USE ON ROCKETS AND SATELLITES [CHAINE DE MESURE DE RAYONNEMENT INFRAROUGE AVEC DETECTEUR PNEUMATIQUE UTILISABLE SUR FUSEES ET SATELLITES]
M. Chatanier and G. Gauffre *In* CNES 2nd Symp. on Optics 1969 p 128-132 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

N72-12645# Engins Matra, Velizy (France).
THE MATRA ONBOARD CAMERA [CAMERA EMBARQUABLE MATRA]
J. Hascoet *In* CNES 2nd Symp. on Optics 1969 p 133-139 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

N72-12646# Centre National de la Recherche Scientifique, Verrieres-Le-Buisson (France). Service de Technologie Spatiale.
PRINCIPAL ACHIEVEMENTS OF THE SECTION "PHYSIQUE DEVELOPMENT" [PRINCIPALES REALISATIONS DE LA SECTION PHYSIQUE DEVELOPPEMENT]
J. Denis *In* CNES 2nd Symp. on Optics 1969 p 140-150 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

N72-12648# Centre National de la Recherche Scientifique, Verrieres-Le-Buisson (France). Service de Technologie Spatiale.
LUMINESCENT CALIBRATION SOURCE [SOURCE DE CALIBRATION A LUMINESCENCE]
A. Rouscilles *In* CNES 2nd Symp. on Optics 1969 p 154-156 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

N72-12656# Centre National de la Recherche Scientifique, Marseilles (France). Lab. d'Astronomie Spatiale.
THE VIDICON AS A PHOTOMETRIC MEASURING APPARATUS: NUMERICAL PROCESSING OF IMAGES [LE VIDICON COMME APPAREIL DE MESURE PHOTOMETRIQUE: TRAITEMENT NUMERIQUE DES IMAGES]
A. ILebaria and A. Roussin *In* CNES 2nd Symp. on Optics 1969 p 250-267 refs In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N72-12406 National Lending Library for Science and Technology, Boston Spa (England).
THEORETICAL AND EXPERIMENTAL STUDIES OF ANTIFRICTION BEARINGS WITH SOLID LUBRICANTS Abridged Ph.D. Thesis - Technische Hochschule Darmstadt
Wolfgang Hueber [1970] 14 p refs Transl. into ENGLISH from Schmiertechnik Technol. v. 17, no. 6, 1970 p 269-273
(NLL-Risley-Tr-2221-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The processes occurring in an antifriction bearing to which solid lubricants have been applied are described. Experimental and theoretical studies provide the criteria determining the useful life of such bearings. An equation is developed which is valid for all geometrically similar types of bearings, and suggestions for the design and application of antifriction bearings with solid lubricants included. Author

N72-12407 Mitsubishi Heavy-Industries, Ltd., Tokyo (Japan).
CHARACTERISTICS AND VARIOUS PROBLEMS OF COILAYER VESSEL
Tsukumo Uno, Yoshimitsu Uto, Yasuhiro Iwasaki, and Toshikazu Shinkawa Aug. 1971 9 p refs
(MTB-73) Copyright. Avail: Issuing Activity

The techniques and materials used to produce multi-wall pressure vessels are discussed. Problems involved in welding, stress relief annealing, and corrosion resistance are presented. The mechanical properties of the finished pressure vessels and tests to determine the strength of the vessel are described. Author

N72-12408* Boeing Co., Seattle, Wash.
FORMING TOOL FOR RIBBON OR WIRE Patent
Ken Anacker, inventor (to NASA) Issued 15 Jun. 1971 8 p Filed 16 Dec. 1968 Sponsored by NASA
(NASA-Case-XLA-05966; US-Patent-3,584,660;
US-Patent-Appl-SN-784544; US-Patent-Class-140-105;
US-Patent-Class-72-307) Avail: US Patent Office CSCL 13I

A device for bending metal ribbon or wire material at selected angles with itself is described. Bending also occurs at selected intervals along the length of the material. A common operating member provides the selective control over the length of these intervals and the angularity of the bends. Official Gazette of the U.S. Patent Office

N72-12409* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THERMOSTATIC ACTUATOR Patent
Lloyd J. Derr and Robert A. Tobias, inventors (to NASA) Issued 13 Jul. 1971 18 p Filed 19 Aug. 1969 Supersedes N70-35431 (08 - 19, p 3546
(NASA-Case-NPO-10637; US-Patent-3,591,960;
US-Patent-Appl-SN-851298; US-Patent-Class-60-23;
US-Patent-Class-337-354; US-Patent-Class-337-359;
US-Patent-Class-337-75; US-Patent-Class-236-68) Avail: US Patent Office CSCL 13I

A thermostatic actuator for imparting displacement to mechanical linkages is described. The instrument depends upon the expansion of a bimetallic element to extend a plunger against the restraining effects of a spring. Upon extension, the plunger engages a catch and is held in position against changes caused by a reduction in temperature. An increase in temperature will cause the plunger to extend further and become engaged in a new position. Author

N72-12410*# Ampex Corp., Redwood City, Calif.
THE DYNAMIC CHARACTERISTICS OF A TURBO-ROTOR SIMULATOR SUPPORTED ON GAS-LUBRICATED FOIL BEARINGS. PART 1: RESPONSE TO ROTATING IMBALANCE AND UNIDIRECTIONAL EXCITATION
L. Licht [1970] 40 p refs 2 Vol.
(Contract NAS3-11826)
(NASA-CR-124620) Avail: NTIS CSCL 13I

A sixteen-inch rotor, weighing approximately twenty-one pounds, was supported by air-lubricated foil bearings. In physical size and in mass distribution, the rotor closely matched that of an experimental Brayton cycle turboalternator unit. The rotor was stable in both vertical horizontal attitudes at speeds up to 50,000 rpm. A detailed description of the experimental apparatus and of the foil bearing design are given. The paper contains data on response of the rotor to rotating imbalance, symmetric and asymmetric, and to excitation by means of a vibrator (shake table). It is concluded that the gas-lubricated foil bearing suspension is free from fractional frequency whirl and suffers no loss of load capacity when excited at frequency equal to half the rotational speed. In contrast to rigid gas bearings, the foil bearing imposes no stringent requirements with respect to dimensional tolerances, cleanliness, or limitations of journal motion within the narrow confines of bearing clearance. Author

N72-12411*# Ampex Corp., Redwood City, Calif.
THE DYNAMIC CHARACTERISTICS OF A TURBO-ROTOR SIMULATOR SUPPORTED ON GAS-LUBRICATED FOIL BEARINGS. PART 2: OPERATION WITH HEATING AND THERMAL GRADIENTS
L. Licht [1970] 24 p refs 2 Vol.
(Contract NAS3-11826)
(NASA-CR-124621) Avail: NTIS CSCL 13I

A high speed rotor, supported by gas-lubricated foil bearings, is free from self-excited whirl and displays no loss of load capacity when vibrated at frequency equal to the rotational speed. It is demonstrated that in addition to tolerance of geometrical imperfections, misalignment and foreign particles, the foil bearing performs well at elevated temperatures and accommodates appreciable temperature gradients. The foil bearing is endowed with superior wipe-wear characteristics and the flexibility of the foil accounts not only for the stability of the foil bearing, but also for its accommodation of, and compensation for, distortion, contamination, and contact. Author

N72-12412# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
PERFORMANCE FACTORS FOR CIRCULAR, HYDROSTATIC GAS-LUBRICATED THRUST BEARINGS. PART 2: MULTIPLE INLET THRUST
E. H. Dudgeon and M. C. Maki Oct. 1971 68 p refs
(NRC-12235-Pt-2; MT-63) Avail: NTIS

A general design procedure for multiple-inlet gas thrust bearings has been derived. Dimensionless load and flow factors have been calculated for a wide range of bearing parameters using a conformal transformation procedure proposed by Mori and Yabe. These factors are combined with empirical correlations for the bearing entry losses to provide a simple, convenient design procedure. The predicted performances are compared with a number of experimental studies. The results indicate: good agreement for both flow and load prediction with orifice-compensate bearings; fair agreement for load prediction but poor agreement for flow prediction with inherently-compensated bearings. The reasons for the latter discrepancy are discussed. Author

N72-12413*# General Motors Corp., Indianapolis, Ind. Allison Div.
DESIGN OF AIRCRAFT TURBINE FAN DRIVE GEAR TRANSMISSION SYSTEM
E. Dent, R. A. Hirsch, and V. W. Peterson Washington NASA Mar. 1970 88 p
(Contract NAS3-12417)
(NASA-CR-72735) Avail: NTIS CSCL 13I

The following basic types of gear reduction concepts were studied as being feasible power train systems for a low-bypass-ratio, single-spool, geared turbofan engine for general aircraft use: (1) single-stage external-internal reduction, (2) gears (offset shafting), (3) multiple compound idler gear system (concentric shafting), and (4) star gear planetary system with internal ring gear final output member (concentric shafting-counterrotation). In addition, studies were made of taking the accessories drive power off both the high-speed and low-speed shafting, using either face gears or spiral bevel gears. Both antifriction and sleeve-type bearings were considered for the external-internal and star-planet reduction concepts. Author

N72-12414*# Scientific Translation Service, Santa Barbara, Calif.
INVESTIGATION OF FRICTIONAL PROCESSES BY MEANS OF EXOELECTRON EMISSION Ph.D. Thesis
Dieter Fischer Washington NASA Nov. 1971 65 p refs Transl. into ENGLISH of doctoral dissertation "Untersuchung von Reibungsvorgaengen mit Hilfe der Exoelektronenemission" Berlin, Berlin Tech. Univ., 1970 p 1-65
(Contract NASw-2035)
(NASA-TT-F-14044) Avail: NTIS CSCL 20K

Exoelectron emission was studied after aluminum, copper, and iron surfaces were activated by friction. Experiments were done with different metal combinations and at various partial pressures of oxygen, with and without water vapor. Decay curves were plotted, and glow curves were measured by heating the metals after emission decay. Results show that exoelectron emission depends on the chemical nature and thickness of the oxide layer on the metal. The emission appears to be a power function of oxygen pressure during friction, indicating that emission can be used to measure thickness of oxide layers. Exoelectron emission is a very sensitive means of measuring transfer of one metal to another during friction when the metals are different enough to produce distinguishable emission phenomena. Author

N72-12415# Joint Publications Research Service, Washington, D.C.
BROACHING AND WORK HARDENING THE BLADE SHAFTS OF GAS TURBINE ENGINES
V. V. Chernyshev, M. S. Rakhmarova, and G. B. Deych 3 Nov. 1971 220 p refs Transl. into ENGLISH of the book "Protyagivaniye i Uprochneniye Khvostovikov Lopatok Gazoturbinnykh Dvigateley" Moscow, Mashinostroyeniye Press, 1971 p 1-218
(JPRS-54386; UDC-629.7.621.44:621.919.1.002) Avail: NTIS

Experimental studies and industrial experience in broaching the herringbone shafts of turbine vanes and shafts of the fishtail type and the prismatic flanges of compressor blades manufactured from new types of heat-resistant and titanium steels are discussed. Structural designs are presented for broaches made of R18 steel and broaches tipped with VK8 alloy and also guides, fastenings and an automated attachment of the rotor type used on all-purpose broaching machines. The broaching process on a special continuous-action semiautomatic machine is described. The technical-economic effectiveness of broaching the blade shafts is calculated. The results of investigating the effect of geometric and technological factors of the broaching process on the cutting force, surface roughness, work hardening and residual stresses and also the results of strength testing are discussed. Recommendations are made with respect to the technological process of hardening the blade shafts to improve their reliability and reserve. A procedure is presented for studying the axial residual stresses in herringbone shafts. Author

N72-12416*# Electronic Communications, Inc., St. Petersburg, Fla.
STUDY OF BONDING METHODS FOR FLIP CHIP AND BEAM LEADED DEVICES Final Report
H. C. Rudd and D. C. Colbert Oct. 1971 60 p ref
(Contract NAS8-25615)
(NASA-CR-121038; SIER-71-0282) Avail: NTIS CSCL 13H

The results are presented of a comprehensive study and evaluation for the bonding of flip chip and beam leaded devices onto hybrid microcircuit substrates used in high reliability space applications. The program included the evaluation of aluminum flip chips, solder (silver/tin) bump chips, gold beam leaded devices, and aluminum beam leaded devices. Author

N72-12417*# Denver Univ., Colo. Industrial Economics Div.
APPLICATIONS OF AEROSPACE TECHNOLOGY IN INDUSTRY, A TECHNOLOGY TRANSFER PROFILE: LUBRICATION
James P. Kottenstette, James E. Freeman, Conrad R. Heins, William M. Hildred, F. Douglas Johnson, and Eileen R. Staskin Jul. 1971 87 p refs
(Grant NSR-06-004-063)
(NASA-CR-123418) Avail: NTIS CSCL 11H

Technology transfer in the lubrication field is discussed in terms of the movement of NASA-generated lubrication technology into the private sector as affected by evolving industrial requirements. An overview of the field is presented, and NASA technical contributions to lubrication technology are described. Specific examples in which these technologies have been used in the private sector are summarized. F.O.S.

N72-12418*# Denver Univ., Colo. Industrial Economics Div.
APPLICATIONS OF AEROSPACE TECHNOLOGY IN INDUSTRY, A TECHNOLOGY TRANSFER PROFILE: CONTAMINATION CONTROL
Jul. 1971 94 p refs
(Grant NSR-06-004-063)
(NASA-CR-123421) Avail: NTIS CSCL 13H

The strong influence NASA-sponsored research has had on the development of solutions to difficult contamination problems is considered. The contamination control field is comprised of an industrial base, supplying the tools of control; a user base, adopting control techniques; and a technical base, expanding the concepts of control. Both formal and informal mechanisms used by NASA to communicate a variety of technical advances are reviewed and certain examples of the expansion of the user base through technology transfer are given. Issues related to transfer of NASA-generated contamination control technology are emphasized. Author

N72-12419*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN STUDY OF SHAFT FACE SEAL WITH SELF-ACTING LIFT AUGMENTATION. 5: PERFORMANCE IN SIMULATED GAS TURBINE ENGINE OPERATION
Lawrence P. Ludwig and Robert L. Johnson Washington Dec. 1971 20 p refs
(NASA-TN-D-6563; E-6312) Avail: NTIS CSCL 11A

The feasibility and the noncontact operation of the self-acting seal was demonstrated over a range of simulated gas turbine engine conditions from 200 to 500 ft/sec sliding speed. Sealed pressure differentials were 50 to 300 psi and sealed temperatures were 150 to 1200 F. Low leakage (about 1/10 that of conventional labyrinth seals) was exhibited in two endurance runs (200 and 338 hr) at 400 ft/sec, 200 psi and 1000 F (gas temperature). For these endurance runs, the self-acting pad wear was less than 3.8 micrometers (0.00015 in.); this low wear was attributed to the noncontact operation of the primary seal. Operating problems identified were fretting wear of the secondary seal and erosion of the primary seal by hard particles. Author

N72-12420*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELASTOHYDRODYNAMIC FILM THICKNESS MEASUREMENTS WITH ADVANCED ESTER, FLUOROCARBON, AND POLYPHENYL ETHER LUBRICANTS TO 589 K (600 F)
Richard J. Parker and Jerrold W. Kannel Washington Dec. 1971 25 p refs
(NASA-TN-D-6608; E-6440) Avail: NTIS CSCL 11H

Elastohydrodynamic (EHD) film thicknesses have been measured, by means of an X-ray technique, under conditions that closely simulate the ball-race contact in advanced turbine engine thrust bearings. The experiments were conducted with a rolling-disk machine using disks which yield a contact zone similar to that in the actual bearing. Both the rolling and spinning motions of the ball relative to the race were simulated by the apparatus. Four lubricants were evaluated at temperatures to 600 F and maximum Hertz stresses to 350,000 psi. The X-ray film thickness data correlated well with observations of surface distress (or lack thereof) in full-scale bearing tests with the same lubricants under similar conditions of temperature and load. The predicted variation of film thickness with speed and viscosity as verified, although the magnitude of measured film thickness was generally one-half to one-third of predicted values. An effect of stress greater than predicted was consistently observed in the higher stress range. Author

N72-12421*# General Electric Co., Evendale, Ohio. Aircraft Engine Group.
DEVELOPMENT OF THE ACTIVATED DIFFUSION BRAZING PROCESS FOR FABRICATION OF FINNED SHELL TO STRUT TURBINE BLADES
L. G. Wilbers, T. F. Berry, R. E. Kutchera, and R. E. Edmonson Nov. 1971 159 p refs
(Contract NAS3-12433)
(NASA-CR-72844) Avail: NTIS CSCL 13H

The activated diffusion brazing process was developed for attaching TD-NiCr and U700 finned airfoil shells to matching Rene 80 struts obstructing the finned cooling passageways. Creep forming the finned shells to struts in combination with precise preplacement of brazing alloy resulted in consistently sound joints, free of cooling passageway clogging. Extensive tensile and stress rupture testing of several joint orientation at several temperatures provided a critical assessment of joint integrity of both material combinations. Trial blades of each material combination were fabricated followed by destructive metallographic examination which verified high joint integrity.
Author

N72-12422*# TRW Systems Group, Redondo Beach, Calif.
SEAL MATERIAL DEVELOPMENT TEST PROGRAM Final Report
14 Nov. 1971 53 p refs
(Contract NAS9-11866)
(NASA-CR-115278; TRW-20690-6001-R0-00) Avail: NTIS CSCL 11A

A program designed to characterize an experimental fluoroelastomer material designated AF-E-124D, is examined. Tests conducted include liquid nitrogen load compression tests, flexure tests and valve seal tests, ambient and elevated temperature compression set tests, and cleaning and flushing fluid exposure tests. The results of these tests indicate the AF-E-124D is a good choice for a cryogenic seal, since it exhibits good low temperature sealing characteristics and resistance to permanent set. The status of this material as an experimental fluorelastomer is stressed and recommended. Activity includes definition and control of critical processing to ensure consistent material properties. Design, fabrication and test of this and other materials is recommended in valve and static seal applications. Author

N72-12423*# National Aeronautics and Space Administration, Washington, D.C.
VALVE TECHNOLOGY: A COMPILATION
1971 25 p
(NASA-SP-5927(02)) Avail: NTIS CSCL 13K

A technical compilation on the types, applications and modifications to certain valves is presented. Data cover the following: (1) valves that feature automatic response to stimuli (thermal, electrical, fluid pressure, etc.), (2) modified valves changed by redesign of components to increase initial design effectiveness or give the item versatility beyond its basic design capability, and (3) special purpose valves with limited application as presented, but lending themselves to other uses with minor changes. E.H.W.

N72-12424*# Westinghouse Electric Corp., Pittsburgh, Pa.
BASIC INVESTIGATION OF TURBINE EROSION PHENOMENA
W. D. Pouchot, R. E. Kothmann, W. K. Fentress, F. J. Heymann, T. C. Varljen, J. W. H. Chi, J. D. Milton, C. M. Glassmire, J. A. Kyslinger, and K. A. Desai Washington NASA Nov. 1971 378 p refs
(Contract NAS7-390)
(NASA-CR-1830; WANL-TME-1977) Avail: NTIS HC $6.00/MF $0.95 CSCL 21E

An analytical-empirical model is presented of turbine erosion that fits and explains experience in both steam and metal vapor turbines. Because of the complexities involved in analyzing turbine problems, in a pure scientific sense, it is obvious that this goal can be only partially realized. Therefore, emphasis is placed on providing a useful model for preliminary erosion estimates for given configurations, fluids, and flow conditions. Author

N72-12425# Bendix Corp., Southfield, Mich. Research Labs.
INVESTIGATION OF ROTARY ACTUATION TECHNIQUE Final Report, Jan. 1966 - Jul. 1970
Kenneth W. Verge, Ronald G. Read, and Norbert L. Sikora Wright-Patterson AFB, Ohio AFAPL Sep. 1970 319 p refs
(Contract AF 33(615)-3431)
(AD-875752; Rept-5273; AFAPL-TR-70-52) Avail: NTIS HC $6.00/MF $0.95 CSCL 13/7

A unique, high-torque rotary actuation technique applicable to aircraft vehicle control is described. This device, the dynavector actuator, incorporates an integrated captive vane orbital hydraulic motor with a high ratio epicyclic transmission. The demonstration of this rotary actuator technology has been accomplished by the design, fabrication and evaluation testing of a 100,000 in-lb torque capacity drive. Author (GRA)

N72-12426# Mechanical Technology, Inc., Latham, N.Y.
LIQUID METAL BEARINGS TECHNOLOGY FOR LARGE, HIGH-TEMPERATURE, SODIUM ROTATING MACHINERY. FOURTH TOPICAL REPORT: DEVELOPMENT AND TEST OF A HIGH-TEMPERATURE PROXIMITY PROBE FOR USE

IN LIQUID SODIUM
I. Hoogenboom and C. Kissinger Jun. 1971 129 p
(Contract AT(30-1)-3930)
(NYO-3930-11; MTI-71TR27) Avail: NTIS

An inductance-type, proximity-probe system for measurement of bearing film thicknesses and shaft orbits in high temperature, liquid sodium environment was developed, built, and tested. The probe system is designed to operate at temperatures up to 1200 F and gap range of 0.004 in. to 0.080 in., with good linearity over about three-quarters of the range, when using probe pairs connected in push-pull. The probes were tested extensively in both gas and sodium environments, culminating in 684 hours continuous test in a temperature range of 1050 F to 1170 F. The probes operated stably, repeatedly and without undergoing performance changes. An electronic amplification and read-out system was specially designed for use with these probes. This electronic package was also developed, built and successfully utilized in the probe tests. Author (NSA)

N72-12427# Biotechnology, Inc., Falls Church, Va.
DEVELOPMENT OF INFORMATION MEASUREMENT TECHNIQUES FOR QUALITY ASSURANCE OF NAVY AIRCRAFT MAINTENANCE JOB AIDS. PART 1: RESEARCH AND DEVELOPMENT EFFORT Final Report, Jun. 1970 - Jun. 1971
Harold E. Price, Theodore J. Post, and Gretchen Kolsrud Jun. 1971 154 p refs
(Contract N62269-70-C-0395)
(AD-725814) Avail: NTIS CSCL 05/2

The purpose of the study was to develop paper-and-pencil tests to support in-process review of aviation maintenance job aids. Two types of tests were developed, editorial and information content. Application of the tests would result in early detection of inadequacies and corrective feedback to technical writers. Author (GRA)

N72-12428# Biotechnology, Inc., Falls Church, Va.
DEVELOPMENT OF INFORMATION MEASUREMENT TECHNIQUES FOR QUALITY ASSURANCE OF NAVY AIRCRAFT MAINTENANCE JOB AIDS. PART 2: IN-PROCESS REVIEW TEST DESCRIPTIONS AND PROCEDURES Final Report, Jun. 1970 - Jun. 1971
Harold E. Price, Theodore J. Post, and Gretchen Kolsrud Jun. 1971 105 p
(Contract N62269-70-C-0395)
(AD-725815) Avail: NTIS CSCL 05/2

The purpose of this study was to develop paper-and-pencil tests to support in-process review of aviation maintenance job aids. This volume was specifically prepared for use by publications review specialists. To this extent, it concentrates on test descriptions and procedures. The tests were prepared as part of an advanced development effort and are intended strictly to be supportive materials for the publications review specialist. The tests possess an added value, too. Since they can also be used as guidelines for the preparation of manuscripts, it is hoped that contractors preparing technical publications will find them to be helpful in that way. GRA

N72-12429# Biotechnology, Inc., Falls Church, Va.
DEVELOPMENT OF INFORMATION MEASUREMENT TECHNIQUES FOR QUALITY ASSURANCE OF NAVY AIRCRAFT MAINTENANCE JOB AIDS. PART 3: IN-PROCESS REVIEW TEST FORMS Final Report, Jun. 1970 - Jun. 1971
Harold E. Price, Theodore J. Post, and Gretchen Kolsrud Jun. 1971 52 p
(Contract N62269-70-C-0395)
(AD-725816) Avail: NTIS CSCL 05/2

The purpose of the study was to develop paper-and-pencil tests to support in-process review of aviation maintenance job aids. Six types of tests were developed. Four of these tests concern editorial quality of draft manuscripts; the remaining two tests address the adequacy of information content appearing in the manuscript to be evaluated. To facilitate test administration, a set of forms has been developed for each of the six tests. Part II of this report (AD-725815) describes each of these tests and presents detailed instructions for completing the test forms. After the reviewer is familiar with the test procedures, a more truncated version of the test procedures is appropriate for field use. This part presents that truncated version. Only the test forms and key guidelines for their use are included. GRA

N72-12430# Metcut Research Associates, Inc., Cincinnati, Ohio.
MACHINABILITY PARAMETERS ON NEW AND SELECTIVE AEROSPACE MATERIALS Final Technical Report, 1 Aug. 1969 - 1 Jun. 1971
Norman Zlatin, Michael Field, John D. Christopher, and John B. Kohls 1 Jun. 1971 370 p
(Contract F33615-69-C-1925; AF Proj. 708-9)
(AD-725895; Rept-1070-13800-F; AFML-TR-71-95; IR-708-9-F) Avail: NTIS MF $6.00/HC $0.95 CSCL 13/8

Four groups of alloys of current interest to the aerospace industry were selected for the machinability studies. The four groups of alloys consisted of (1) ultra high strength steels; (2) titanium alloys; (3) high temperature alloys; and (4) hot work die steels. Tables of recommendations were compiled from the machining tests conducted for various machining operations on all of the alloys. Drilling tests were conducted on boron epoxy composites with high speed steel, carbide, and diamond core drills. The results indicated that, in general, high speed steel and carbide drills are not satisfactory for drilling this material. A study was also conducted on the surface integrity of drilled and tapered holes in a titanium alloy. The results indicated that even under careful machining conditions, serious defects regarding the surface integrity of the hole can occur. Drilling tests with ultrasonic assist were conducted on a titanium alloy. It was found that the ultrasonic assist was beneficial when the holes were drilled dry. Author (GRA)

N72-12431# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
THE INFLUENCE OF THE THERMOMECHANICAL PROCESSING ON THE MECHANICAL PROPERTIES OF BETA 3 TITANIUM ALLOY Final Report, 1 Sep. 1969 - 31 Dec. 1970
James A. Roberson and Attwell M. Adair Mar. 1971 12 p refs
(AF Proj. 7021)
(AD-726099; ARL-71-0031) Avail: NTIS CSCL 13/8

The effects of extrusion and cold swaging on the structure and properties of Beta III titanium were investigated; die loads for extrusion were determined at various temperatures and compared to die loads for other alloys; the effects of age hardening after various thermal and mechanical treatments were studied. Optimum tensile properties were obtained in extruded and aged material when the extrusion temperature was low and the cooling rate was high. The die loads during extrusion compared favorably with those of other titanium alloys. Cold swaging prior to age hardening increased hardness and tensile strength but caused embrittlement when the amount of deformation was small. Ductility was restored by large amounts of cold swaging. Fracture toughness was universely proportional to ultimate tensile strength. These observations are explained on the basis of metallography, electron microscopy, and X-ray diffraction. Author (GRA)

N72-12432# Naval Material Industrial Resources Office, Philadelphia, Pa.
NAVMIRO MANUFACTURING TECHNOLOGY BULLETIN, NUMBERS 1 THRU 12, DECEMBER 1969 TO NOVEMBER 1970
Nov. 1970 81 p
(AD-725614) Avail: NTIS CSCL 13/8

The document is a compilation of manufacturing techniques that can be employed in varied industries. GRA

N72-12433# Naval Civil Engineering Lab., Port Hueneme, Calif.
TECHNICAL EVALUATION OF DIVER HELD POWER TOOLS Technical Report, Nov. 1968 - Jun. 1970
S. A. Black and F. B. Barrett Jun. 1971 61 p
(Proj. YF 38.535.003.01.002)
(AD-726161; NCEL-TR-729) Avail: NTIS CSCL 13/8

Pneumatic and hydraulic hand-held power tools were evaluated by divers performing realistic underwater tasks. These tasks included drilling steel and aluminum, nut running and tightening, grinding metal, and chain sawing wood. An on-the-site observer monitored diver performance time for each task. Diver skill in effective tool utilization is very important in working underwater. At test depths to 60 feet, hydraulic tools were very effective and practical, while pneumatic tools, although effective, required excessive maintenance. At greater depths, hydraulic tools retain their effectiveness, but pneumatic tools lose effectiveness because of the compressibility of gas. Hydraulic tools generally supply more energy per unit of tool weight than do pneumatic tools; thus, the diver can perform work more rapidly using hydraulic tools. Author (GRA)

N72-12434# Naval Postgraduate School, Monterey, Calif.
DYNAMIC ANALYSIS OF CAMS M.S. Thesis
Robert Viggo Andersen Jun. 1971 93 p refs
(AD-728660) Avail: NTIS CSCL 13/9

The thesis deals with the computer simulated, elastic link model of an automobile cam actuated valve train. Examined are the dynamic responses to such situations as: valve bounce, pushrod bounce, excessive cam speed, cam surface machining errors, and cam profiles. The model is adaptable to various types of mechanisms and lends itself well to the incorporation on a computer graphics display. Author (GRA)

N72-12435# Midwest Research Inst., Kansas City, Mo.
WEAR RATE RELATIONSHIPS FOR THREE LUBRICANT COMPACT MATERIALS Technical Report, 1 Oct. 1970 - 1 May 1971
Karl R. Mecklenburg Wright-Patterson AFB, Ohio AFML Jul. 1971 85 p refs
(Contract F33615-69-C-1236; AF Proj. 7340; AF Proj. 7343)
(AD-728661; AFML-TR-71-123) Avail: NTIS CSCL 11/8

The report is concerned with the wear rates of three lubricant compact materials, selected as representative of a new class of engineering compounds. The compacts were subjected to various combinations of loads and sliding velocities, from 200 to 1,600 psi and from 1.50 to 9.60 ft/sec. Weight loss data as a function of time are presented, showing that wear rate does not change significantly with time. Repeatability, effects of operational eccentricity, and temperature are also discussed. A statistical interpretation of the data is presented, including the concept of bands of wear rate values instead of simple arithmetic averages. Using the statistically acceptable spread of wear rate values, equations relating wear rate, load, and sliding velocity were formulated. Author (GRA)

N72-12436# Army Foreign Science and Technology Center, Charlottesville, Va.
EVERYTHING BEGINS IN THE FOUNDRIES
E. Muslin 21 Jul. 1971 12 p Transl. into ENGLISH from Bse Nachinaetcya S Litya, Tekhn. Molodezhi
(AD-728650; FSTC-HT-23-517-71) Avail: NTIS CSCL 13/8

Foundries are basic to modern technology and are being up-dated to meet the demands of the space age. New methods of transporting molten metal, making molds, and cleaning castings are discussed. Author (GRA)

N72-12437# Bendix Corp., South Bend, Ind. Energy Control Div.
COMPONENT IMPROVEMENT PROGRAM FOR AIRCRAFT BRAKE PISTON SEALS Final Report, Dec. 1969 - May 1971
Richard F. Horner Wright-Patterson AFB, Ohio ASD Aug. 1971 39 p refs
(Contract F33657-70-C-0508; WM Proj. 9-163-2605)
(AD-728216; ASD-TR-71-43) Avail: NTIS CSCL 13/7

Hydraulic fluid leakage in aircraft brakes has long been a problem for the Air Force. This leakage commonly occurs when the equipment is operated in a low temperature environment. In some cases, the leakage problem was resolved by using special nonstandard 'O' ring seals at a higher cost. Consequently, it is desirable to determine if a revision to the standard gland dimensions will improve cold temperature performance of MS-28775 series 'O' ring seals. The primary purpose of this investigation was to determine optimum gland dimensions for use with existing MS-28775 'O' ring packings for aircraft brake dynamic seals. A secondary objective was to evaluate new materials for seals. Author (GRA)

N72-12438# Army Materiel Command, Washington, D.C.
QUALITY ASSURANCE: GUIDANCE TO NONDESTRUCTIVE TESTING TECHNIQUES
29 Apr. 1970 181 p
(AD-728162; AMCP-702-10) Avail: NTIS CSCL 14/2

Reference material is provided on the following topics: Visual inspection; Liquid penetrant inspection; Magnetic particle inspection; X- and gamma-ray film radiography; Fluoroscopic and electronic X-ray and gamma ray imaging systems; Sonic and ultrasonic NDT; Eddy current NDT; Conductivity NDT; Microwave NDT; Infrared NDT; Liquid crystal NDT; Kryptonation NDT; Corona discharge NDT; Leak testing; Effectiveness of NDT; Comparative NDT. GRA

N72-12439# Massachusetts Univ., Amherst. School of Engineering.
PENETRATION REINFORCEMENT DESIGN FOR SPHERICAL PRESSURE HULLS
George R. Kidd Jul. 1971 47 p refs
(Contract N00014-68-A-0146; NR Proj. 200-016)
(AD-728772; THEMIS-UM-71-3) Avail: NTIS CSCL 13/10

Basic criteria are given for the design of reinforcements for penetrations in spherical pressure hulls. Specific design procedures are listed for cylindrical coaming-type reinforcements under three different loading are included. Author (GRA)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N72-12440* Auburn Research Foundation, Inc., Ala.
LASER COOLANT AND ULTRAVIOLET FILTER Patent
John R. Rasquin and Fred R. McDevitt, inventors (to NASA) Issued 13 Jul. 1971 14 p Filed 2 Oct. 1969 Supersedes N70-22250 (08-09, p 1645
(NASA-Case-MFS-20180; US-Patent-3,593,194;
US-Patent-Appl-SN-863276; US-Patent-Class-331-94.5;
US-Patent-Class-350-1; US-Patent-Class-350-312) Avail: US Patent Office CSCL 20E

Ruby lasers are cooled and protected from detrimental radiation by means of a solution of copper sulfate in an alcohol solvent. The coolant-filter solution is disposed between the ruby crystal and the laser-actuating light source so as to absorb short wavelength ultraviolet radiation, while allowing energy in the ruby pumping bands to pass through. Circulation of the solution removes heat from the laser crystal and improves its operation.
Official Gazette of the U.S. Patent Office

N72-12441# Institut Franco-Allemand de Recherches, St. Louis (France).
HOLOGRAPHIC RECORDING OF HIGH SPEED OBJECTS. APPLICATION TO THE INVESTIGATION OF THE SONIC

BOOM AS WELL AS THE WAKE OF HYPERSONIC PROJECTILES Final Report, 1970
P. Smigielski and A. Hirth 15 Jun. 1971 38 p refs In FRENCH
(Rept-11/71) Avail: NTIS

A Q-switch-monomode-ruby laser was used for holographic recording of both simulated sonic booms and wakes of projectiles in hypersonic flight. The gaseous objects were visualized by means of the following techniques: (1) differential interferometry in polarized light as well as Schlieren method with defocused phase-plate; and (2) interferometry by double exposure to both directional lighting and diffused transmitted and reflected lighting. Author

N72-12442*# National Aeronautics and Space Administration, Washington, D.C.
NUMERICAL EXPERIMENTS ON LASER SOUNDING OF THE ATMOSPHERE FROM OUTER SPACE
V. E. Zuyev, G. M. Krekov, and A. I. Popkov Nov. 1971 14 p refs Transl. into ENGLISH of Russian conf. paper from Inst. of Atmospheric Optics of the Siberian Branch, Acad. of Sci. of the USSR, Tomsk Presented at 22d Intern. Astronaut. Federation Congr., Brussels, Sep. 1971 p 1-14
(NASA-TT-F-14077) Avail: NTIS CSCL 20E

A numerical method, designed to measure the composition and structure of the upper atmosphere from outer space, is presented. The method, an optical sounding one, measures electron density variations and cosmic dust layers. The method also provides a means by which spatial properties may be estimated. E.H.W.

N72-12443*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TURBULENCE MEASUREMENTS USING THE LASER DOPPLER VELOCIMETER
John W. Dunning, Jr. and Neil S. Berman (Ariz. State Univ.) [1971] 16 p refs Presented at the Symp. on Turbulence in Liquids, Rolla, Missouri, 4-6 Oct. 1971; sponsored by Missouri Univ.
(NASA-TM-X-67969; E-6683) Avail: NTIS CSCL 20E

The photomultiplier signal representing the axial velocity of water within a glass pipe is examined. It is shown that with proper analysis of the photomultiplier signal, the turbulent information that can be obtained in liquid flows is equivalent to recent hot film studies. In shear flows the signal from the laser Doppler velocimeter contains additional information which may be related to the average shear. Author

N72-12444*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
A STUDY OF TRANSIENT STIMULATED RAMAN SCATTERING AND SELF-FOCUSING IN THE PICOSECOND TIME REGIME
John F. Reintjes Sep. 1971 215 p refs
(Grant NGR-22-007-117; Contracts N00014-67-A-0298-0006; N00014-67-A-0298-0005; N00014-67-A-0298-0008)
(NASA-CR-123478; NR-372-012; TR-625) Avail: NTIS CSCL 20E

Two third order processes, stimulated Raman scattering and self-focusing, with picosecond pulses are studied. In the case of transient stimulated scattering, the gain is reduced from the steady state value, and qualitatively new features, such as shortening and delay of the Stokes pulse relative to the laser pulse, appear. These predictions are extended to realistic laser pulses, and experiments confirm all of the theoretical predictions. The self-focusing and frequency broadening of picosecond pulses is studied in the absence of stimulated Raman scattering in several materials with large orientational Kerr constants. Measurements of the relaxation time indicate that the orientational Kerr effect is important in the self-focusing of picosecond pulses. Self-focused filaments are observed to propagate with constant diameters over a distance greater than 10 cm, but disappear before the end of a 20 cm cell. The filaments radiate light continuously along their path and the spectrum of the light shows that the frequency content extends symmetrically for several hundred wave numbers on either side of the laser frequency. Author

N72-12445# ARO, Inc., Arnold Air Force Station, Tenn.
NOMOGRAMS FOR THE DOPPLER SHIFT VELOCIMETER Final Report
George H. Mycroft and Frank H. Smith, Jr. AEDC Jul. 1971 18 p refs
(Contract F40600-71-C-0002; AF Proj. 4344)
(AD-726090; AEDC-TR-71-102; ARO-OMD-TR-70-340) Avail: NTIS CSCL 20/6

The preliminary design of a laser Doppler velocimeter (LDV) for a particular application requires the determination of the frequency-to-velocity conversion constant and the spacial resolution of the focal volume. These parameters give the frequency range required of the signal processing electronics and the size of the region in which velocity measurements are being made. These values are determined from the laser wavelength, the focal length of the focusing lens, the angle of the LDV beam pair intersection, and the diameter of the focused beams at the intersection. A set of nomographic scales has been developed to allow rapid and accurate determination of these parameters. They are also particularly useful in evaluating the effects of parameter variation and optimization of the LDV. Author (GRA)

N72-12446# ARO, Inc., Arnold Air Force Station, Tenn.
BALANCED DETECTION FOR THE DUAL SCATTER LASER DOPPLER VELOCIMETER Final Report, Jun. - Jul. 1970
W. H. Goethert AEDC Jun. 1971 22 p refs
(Contract F40600-71-C-0002; AF Proj. 4344)
(AD-726093; AEDC-TR-71-70; ARO-OMD-TR-71-17) Avail: NTIS CSCL 20/6

Single particles traversing the region of interest produce both a DC term and an AC term as seen by a photomultiplier. The AC term is directly proportional to the particle velocity. In order to accurately determine the frequency of this burst of information, the DC term is rejected by electronic filtering technique. At higher particle velocities the DC rejection becomes difficult, if not impossible, and an alternate technique is necessary. This report describes a balanced detection method to reject the DC term optically without electronic filters. Balanced detection rotates one of the laser beams in a dual scatter laser Doppler velocimeter such that light scattering from the probe volume has the two scattering components 90 degrees apart. A polarization-sensitive beam splitter is employed to split the scattered light into two components with one beam undergoing a 90-degree phase shift. Two photomultipliers are used to detect each signal. Author (GRA)

N72-12447# Oregon Graduate Center for Study and Research, Portland.
MULTIWAVELENGTH LASER PROPAGATION STUDY, 3 Quarterly Progress Report, 16 Mar. - 15 Jun. 1971
J. Richard Kerr Jul. 1971 8 p refs
(Contract N00014-68-A-0461-0001; ARPA Order 306)
(AD-726203; Rept-1154-12; QPR-4) Avail: NTIS CSCL 20/6

A preliminary experimental study has been made of the nature and effects of the intermittency of turbulence on the scintillation of multiwavelength laser beams. It has been concluded that the effects are substantial, and that recently begun theoretical efforts which take the intermittency into account should be expanded. The results are sufficient to permit the definition of a possible detailed experimental study at a later date. These results and those reported earlier are presented in a paper which is in preparation. Current measurements involve transmitter-aperture effects, which will be followed by a longer-path study of scintillation phenomena. Author (GRA)

N72-12448# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
RESEARCH AND DEVELOPMENT PROGRAMS Quarterly

Report, 1 Oct. - 31 Dec. 1970
C. F. Noyes, R. E. Walker, R. K. Frazer, N. Rubenstein, and R. W. Allen 31 Dec. 1970 42 p refs
(Contract N00017-62-C-0604)
(AD-726202; APL-U-RQR/70-4) Avail: NTIS CSCL 20/5

A record of the activities of the Applied Physics Laboratory in the field of Research and Development is issued in three volumes. In this volume results are reported on work in the following categories: Microelectronics Laboratory status and improvements; chemical laser systems, fast flow chemical laser experiment; limitations of current radomes; structural elastic studies; compact transpiration cooling studies; heat flux calorimeter development; turbulent transport with blowing and suction; turbulent boundary layer analysis; a wideband array antenna system; gaseous jet penetration experiments; Scramjet propulsion research; a Harpoon inlet model structural design; radar observations of land breeze fronts at Wallops Island, Va.; and guiding center motion of a charged particle in an inhomogeneous magnetic field. Author (GRA)

N72-12449# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
STIMULATED RAMAN AND CONCENTRATION SCATTERING Final Technical Report, Jun. 1968 - Jun. 1971
N. Bloembergen Jul. 1971 7 p refs
(Contract DAHC04-68-C-0037; ARPA Order 675)
(AD-728428) Avail: NTIS CSCL 20/6

The activities on stimulated Raman and concentration scattering during the duration of the contract June 1968 - June 1971 are summarized. A list of publications, technical reports and personnel is given. Author (GRA)

N72-12450# Georgetown Univ., Washington, D.C. Dept. of Physics.
PRELIMINARY RESULTS FOR LASING THRESHOLD CONDITIONS IN THE SUPERCONDUCTOR INJECTION LASER
J. Bostock, W. D. Gregory, L. Leopold, and W. N. Mathews, Jr. 25 Feb. 1971 23 p refs
(Contracts F44620-68-C-0017; AT(40-1)-3665; THEMIS Proj. 140; AF Proj. 7921)
(AD-726134; AFOSR-70-2403TR) Avail: NTIS CSCL 20/5

The basic physical picture of the superconductor injection laser and the results of self-consistent temperature-dependent threshold current density calculations for Al, V, Ta, and Pb are reviewed. Author (GRA)

N72-12451# American Optical Co., Southbridge, Mass. Central Research Lab.
MULTIPLE DOPED ERBIUM LASER MATERIALS Final Report, 1 Nov. 1969 - 31 Jan. 1971
Richard F. Woodcock Aug. 1971 47 p refs
(Contract DAAB07-70-C-0021; ARPA Order 1464; DA Proj. 79102170255)
(AD-728180; ECOM-0021-F) Avail: NTIS CSCL 20/5

The report presents information in four sections. First, the program is introduced and some historical results from earlier company funded programs are given. The second section deals with the laser material improvement program and covers efforts concerned with optimizing both the core and cladding glasses. Closing section two is a discussion concerning possible advantages that could be obtained by varying the physical laser parameters. Section three presents experimental data and analysis of Er3+ emission spectra in glass, studies of various glasses with enhanced emission of 1536 nm and studies of the crystal field splitting of Er3+ in the near octahedral A site. Finally, a summary and some conclusions are presented. Author (GRA)

N72-12452# Wayne State Univ., Detroit, Mich.
A STUDY OF ENERGY TRANSFER PROCESSES IN MOLECULAR LASERS Final Technical Report, 15 Jan. 1970 - 31 Mar. 1971
Alexander J. Glass, Edward R. Fisher, Ralph H. Kummler, and Richard Marriott 31 May 1971 122 p refs
(Contract DAHC04-70-C-0022; ARPA Order 675-7)
(AD-728054) Avail: NTIS CSCL 20/5

The carbon monoxide laser is one of the most promising systems currently available for the efficient generation of infrared radiation in the wavelength region from 5 to 8 microns. A detailed model of the kinetic processes which govern the performance of this laser has been programmed for the IBM 360/67 computer. The temporal development of vibrational populations has been computed, and shown to converge to steady state solution generated elsewhere from algebraic computation. A careful investigation of scattering data shows an apparent discrepancy in the potential used to describe the interaction of the CO molecule with argon atoms. An experimental facility has been developed for observation of spontaneous emission from various molecular transitions in the CO laser. Author (GRA)

N72-12453# Cornell Univ., Ithaca, N.Y.
VIBRATIONAL ENERGY TRANSFER IN HF/DF-Co2 CHEMICAL LASER SYSTEM Final Report
Ross A. McFarlane and George J. Wolga 31 Jul. 1971 32 p refs
(Contract N00014-67-A-0077-0017)
(AD-728437) Avail: NTIS CSCL 07/4

The experimental method of laser induced vibrational fluorescence has been used to measure the overall rate, k(12), with which the (001) vibrational energy level of CO2 in the lowest electronic state is deactivated through collisions with DF and HF in their lowest electronic and vibrational states. The rate constants were measured both 75 C and 100 C at which temperatures the presence of dimers (D2F2/H2F2) were reduced to negligible proportions. Author (GRA)

N72-12651# Paris Univ., Orsay (France). Inst. d'Optique.
RECENT DEVELOPMENTS IN THE FIELD OF ASPHERIC SURFACES [REALISATIONS RECENTES DANS LE DOMAINE DES SURFACES ASPHERIQUES]
J. P. Marioge *In* CNES 2nd Symp. on Optics 1969 p 178-186 ref In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N72-12454 National Lending Library for Science and Technology, Boston Spa (England).
EXPERIMENTS ON THE COMPATIBILITY OF BERYLLIUM WITH Zr-2.5%Cu ALLOY AND WITH 347 STAINLESS STEEL
M. Champigny, L. Meny, and P. Salaun 22 Sep. 1971 19 p refs Transl. into ENGLISH from Mem. Sci. Rev. Met. (Paris), v. 62, no. 9, 1965 p 671-682 Presented at the Autumn Meeting of the French Met. Soc., Paris, Oct. 1964
(NLL-Trans-LB/G/3085-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Experiments were carried out in the context of the design program for the EL 4 reactor, envisaging the use of beryllium-clad U02 fuel elements with centring structures in Zr-Cu alloy or stainless steel at an operating temperature of 600 - 650 C. The compatibility of beryllium with Zr-2.5%Cu alloy and with stainless steel from 500 to 650 C in vacuum at a mechanical pressure of 30 kg/sq cm has been studied. In all cases, diffusion with welding occurred and the reaction layer/ beryllium bond was

always brittle. The growth kinetics of the layers formed was studied. Some diffusion barriers at 650 C were also tested. A continuous deposit of an oxide not reactive with zirconium would seem suitable for preventing the Be-Zr reaction. For the couple Be/stainless steel, alumina is suitable; but a chromium deposit is not effective, since it diffuses with the beryllium. The quality of the attachment of the diffusion barrier deposit to the centring structures will need checking. Author

N72-12455*# Translation Consultants, Ltd., Arlington, Va.
CERTAIN CAUSES OF THE EFFECT OF SAMPLE PHYSICAL PROPERTIES ON THE ASSIMILATION OF A SUBSTANCE DURING SPECTRAL ANALYSIS OF ALLOYS USING OPTICAL LASERS [NEKOTORYYE PRICHINY VLIYANIYA FIZICHESKIKH SVOYSTVOBRAZTSOVNA POSTUPLENIYE VESHCHESTVA PRI SPEKTRALNOM ANALIZE SPLAVOVS ISPOLZOVANIYEM OPTICHESKIKH KVANTOVYKH GENERATOV]
V. V. Panteleyev and A. A. Yankovskiy Washington NASA Nov. 1971 7 p refs Transl. into ENGLISH from Spektroskopiya, Tr. 4 Sibirsk. Soveschanii, 1965 (Moscow), 1969 p 401-403
(Contract NASw-2038)
(NASA-TT-F-13968) Avail: NTIS CSCL 11F

The radiation of the GSI-1 laser was focussed by a lens on a metal sample at a distance of 200 mm. The reflected radiation from the surface of the sample was focussed by a spherical mirror on the inlet of the calorimeter. The Cu, Al, Ni, Zn, Fe, W, and C showed good correspondence between the fraction of reflected energy and the coefficient of the reflection. Differences were found for Sn and Pb, owing to the low melting points of these metals. The basic portion of the melted metals was emitted parallel to the metal surface, in the form of the vapor. Drops of metal remained in the small depression in the surface of the metal. The energy lost by melting, evaporating, and the heating of the vapor was approximately 15% of the total laser energy of the incident on the sample. It was concluded that the reflection of the radiation from an alloy surface depends on the chemical composition of the alloy. Author

N72-12456*# Battelle Memorial Inst., Columbus, Ohio.
THE EFFECT OF ALLOY COMPOSITION ON THE MECHANISM OF STRESS CORROSION CRACKING OF TITANIUM ALLOYS IN AQUEOUS ENVIRONMENTS Quarterly Progress Report, 11 Jun. - 11 Sep. 1971
D. N. Williams Oct. 1971 23 p refs
(Contract NASw-2242)
(NASA-CR-124613) Avail: NTIS CSCL 11F

Emphasis has been placed on determining the interrelations among the composition, phase structure, deformation, and fracture properties of the alpha phase in susceptible alpha beta alloys. The program is divided into two parts: (1) evaluation of the aqueous stress corrosion susceptibility of a series of alloys that contain various alpha-soluble elements; and (2) investigations of the metallurgical aspects of the mechanism of aqueous stress corrosion cracking. Author

N72-12457*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF INITIAL HYDROGEN CONTENT OF A TITANIUM ALLOY ON SUSCEPTIBILITY TO HOT-SALT STRESS-CORROSION
Hugh R. Gray Washington Nov. 1971 9 p refs
(NASA-TM-X-2404; E-6502) Avail: NTIS CSCL 11F

The Ti-8Al-1Mo-1V alloy was tested in four conditions: mill annealed (70 ppM H), duplex annealed (70 ppM H), vacuum annealed to an intermediate (36 ppM) and a low (9 ppM H) hydrogen level. Material annealed at 650 C (duplex condition) exhibited resistance to hot-salt stress corrosion superior to that exhibited by material in the mill-annealed condition. Reduction of the alloy hydrogen content from 70 to as low as 9 ppM did not influence resistance to hot-salt stress corrosion embrittlement or cracking. Author

N72-12458*# General Electric Co., Evendale, Ohio.
A MODEL FOR MULTIPLE-DROP-IMPACT EROSION OF BRITTLE SOLIDS
O. G. Engel Washington NASA Nov. 1971 107 p refs
(Contract NASw-1481)
(NASA-CR-1943; GESP-610) Avail: NTIS CSCL 11F

A statistical model for the multiple-drop-impact erosion of brittle solids was developed. An equation for calculating the rate of erosion is given. The development is not complete since two quantities that are needed to calculate the rate of erosion with use of the equation must be assessed from experimental data. A partial test of the equation shows that it gives results that are in good agreement with experimental observation. Author

N72-12459*# Scientific Translation Service, Santa Barbara, Calif.
CYCLIC CREEP AND RELAXATION OF HEAT RESISTANT ALLOYS
L. B. Getsov Washington NASA Nov. 1971 11 p refs Transl. into ENGLISH from Probl. Proch. (Moscow), v. 1, no. 5, 1969 p 34-38
(Contract NASw-2035)
(NASA-TT-F-14013) Avail: NTIS CSCL 11F

Studies of the cyclic creep and relaxation in a series of heat resistant alloys at high temperatures showed that it was impossible to extend the calculations of the creep and relaxation characteristics obtained for a static load to those for a variable load. Author

N72-12460*# Ohio State Univ. Research Foundation, Columbus. Dept. of Metallurgical Engineering.
STRESS CORROSION CRACKING OF TITANIUM ALLOYS Semiannual Report, 1 Jul. - 31 Dec. 1970
R. C. May, F. H. Beck, and M. G. Fontana Sep. 1971 142 p refs
(Grant NGL-36-008-051; RF Proj. 2267)
(NASA-CR-124602; Rept-9) Avail: NTIS CSCL 11F

Experiments were conducted to study (1) the basic electrochemical behavior of titanium in acid chloride solutions and (2) the response of the metal to dynamic straining in the same evironment. The aim of this group of experiments was to simulate, as nearly as possible, the actual conditions which exist at the tip of a crack. One of the foremost theories proposed to explain the propagation of stress corrosion cracks is a hydrogen embrittlement theory involving the precipitation of embrittling titanium hydrides inside the metal near the crack tip. An initial survey of the basic electrochemical literature indicated that surface hydrides play a critical role in the electrochemistry of titanium in acid solutions. A comprehensive analysis of the effect of surface films, particularly hydrides, on the electrochemical behavior of titanium in these solution is presented. Author

N72-12461*# Translation Consultants, Ltd., Arlington, Va.
INVESTIGATION OF THE THERMOELECTRIC PROPERTIES OF PALLADIUM-RHODIUM ALLOYS
A. A. Rudnitskiy, R. S. Polyakova, and I. I. Tyurin Washington NASA Nov. 1971 10 p refs Transl. into ENGLISH from Izv. Sektora Platiny, Akad. Nauk SSSR (Moscow), no. 29, 1955 p 190-196
(Contract NASw-2038)
(NASA-TT-F-14036) Avail: NTIS CSCL 11F

The transformation to the solid state in the palladium-rhodium system is studied. The unlimited intersolubility of palladium and beta-rhodium is established, as is the fact that palladium and alpha-rhodium have limited intersolubility. Transition and composition boundaries are established. Author

N72-12462*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STRESS CORROSION CRACKING OF SEVERAL HIGH STRENGTH FERROUS AND NICKEL ALLOYS
Eli E. Nelson 11 Nov. 1971 29 p refs

(NASA-TM-X-64626) Avail: NTIS CSCL 11F

The stress corrosion cracking resistance of several high strength ferrous and nickel base alloys has been determined in a sodium chloride solution. Results indicate that under these test conditions Multiphase MP35N, Unitemp L605, Inconel 718, Carpenter 20Cb and 20Cb-3 are highly resistant to stress corrosion cracking. AISI 410 and 431 stainless steels, 18% Ni maraging steel (250 grade) and AISI 4130 steel are susceptible to stress corrosion cracking under some conditions. Author

N72-12463*# Scientific Translation Service, Santa Barbara, Calif.

FUNDAMENTAL CONSIDERATIONS ON SPINEL FORMATION IN SCALE LAYERS AND ON THE TRANSPORT PROPERTIES OF THE SPINELS

H. Schmalzried Washington NASA Dec. 1971 28 p refs Transl. into ENGLISH from Werkstoffe Korrosion (Weinheim), v. 22, no. 5, May 1971 p 371-382

(Contract NASw-2035)

(NASA-TT-F-14052) Avail: NTIS CSCL 11F

Alloy oxidation is investigated for a certain phase configuration of the ternary system A-B-O. The structure, range of homogeneity, thermodynamics and defect concentrations, of spinels are discussed for numerous examples. The formation of stable coating layers is described. Author

N72-12464*# Scientific Translation Service, Santa Barbara, Calif.

STUDY OF OXYGEN ADSORPTION ON TUNGSTEN THROUGH MEASUREMENT OF WORK FUNCTION VARIATION AND ADHESION COEFFICIENT

H. W. Wassmuth Washington NASA Nov. 1971 26 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), v. 26, no. 4, 1971 p 326-344

(Contract NASw-2035)

(NASA-TT-F-14054) Avail: NTIS CSCL 11F

Oxygen adsorption on polycrystalline tungsten was investigated by means of mass spectrometry over a range of partial oxygen pressures from 10 to the minus 10th power torr to 10 to the minus 6th power torr and temperature from 1000 K to 2800 K. A detailed description of the experimental methods and apparatus used is followed by a diagram-illustrated presentation and discussion of the results obtained. Author

N72-12465*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MACH 1 OXIDATION OF THORIATED NICKEL CHROMIUM AT 1204 C (2200 F)

Carl E. Lowell and William A. Sanders Washington Nov. 1971 23 p refs

(NASA-TN-D-6562; E-6488) Avail: NTIS CSCL 11F

TD NiCr was exposed to a Mach 1, 1-atmosphere gas stream at 1204 C for times up to 50 hours. Weight change, metal thickness loss, X-ray diffraction, metallographic, and electron microprobe analyses were made. Neither surface preparation nor thermal cycling had an appreciable effect on the results. Initially, Cr_2O_3 formed and volatilized, allowing a rapid metal loss rate of 40 microns per hour. After about 1 hour the Cr_2O_3 broke down, resulting in an NiO overgrowth. The metal loss rate then slowed to 2.5 microns per hour and remained constant to 50 hours. Author

N72-12466*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

RELATIVE SUSCEPTIBILITY OF TITANIUM ALLOYS TO HOT-SALT STRESS-CORROSION

Hugh R. Gray Washington Nov. 1971 56 p refs

(NASA-TN-D-6498; E-6417) Avail: NTIS CSCL 11F

Susceptibility of titanium alloys to hot-salt stress-corrosion cracking increased as follows: Ti-2Al-11Sn-5Zr-0.2Si(679), Ti-6Al-2Sn-4Zr-2Mo(6242), Ti-6Al-4V(64), Ti-6Al-4V-3Co(643), Ti-8Al-1Mo-1V(811), and Ti-13V-11Cr-3Al(13-11-3). The Ti-5Al-6Sn-2Zr-1Mo-0.25Si(5621S) alloy was both the least and most susceptible depending on heat treatment. Such rankings can be drastically altered by heat-to-heat and processing variations. Residual compressive stresses and cyclic exposures also reduce susceptibility to stress-corrosion. Simulated turbine-engine compressor environmental variables such as air velocity, pressure, dewpoint, salt concentration, and salt deposition temperature have only minor effects. Detection of substantial concentrations of hydrogen in all corroded alloys confirmed the existence of a hydrogen embrittlement mechanism. Author

N72-12467# Grumman Aerospace Corp., Bethpage, N.Y. Materials and Structural Mechanics Section.

REVIEW OF GRUMMAN STUDIES IN METAL SOLIDIFICATION

C. Li Nov. 1971 13 p refs

(RM-525) Avail: NTIS

A comprehensive review of the phenomena involved in metal solidification is given. Data are included for solidification models and computer solutions to these models. Author

N72-12468*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TENSILE PROPERTIES OF TITANIUM ELECTROLYTICALLY CHARGED WITH HYDROGEN

Robert J. Smith and Dumas A. Otterson Washington Dec. 1971 16 p refs

(NASA-TN-D-6515; E-6470) Avail: NTIS CSCL 11F

Yield strength, ultimate tensile strength, and elongation were studied for annealed titanium electrolytically charged with hydrogen. The hydrogen was present as a surface hydride layer. These tensile properties were generally lower for uncharged titanium than for titanium with a continuous surface hydride; they were greater for uncharged titanium than for titanium with an assumed discontinuous surface hydride. We suggest that the interface between titanium and titanium hydride is weak. And the hydride does not necessarily impair strength and ductility of annealed titanium. The possibility that oxygen and/or nitrogen can embrittle titanium hydride is discussed. Author

N72-12469*# Translation Consultants, Ltd., Arlington, Va.

POLYMORPHIC TRANSFORMATIONS OF RHODIUM

A. A. Rudnitskiy, R. S. Polyakova, and I. I. Tyurin Washington NASA Nov. 1971 10 p refs Transl. into ENGLISH from Izv. Sektora Platiny i Drug. Blagorodn. Metal., Inst. Obshch. i Neorgan. Khim., Akad. Nauk SSSR (Moscow), no. 29, 1955 p 183-189

(Contract NASw-2038)

(NASA-TT-F-14037) Avail: NTIS CSCL 11F

A method for investigating thermal electric phenomena in metals by using the Kurnakov pyrometer is discussed. The polymorphic transformation temperature for rhodium was found to be 1030 deg. The method results in errorless determination of the nature of the curve for the change in the thermal electromotive force in terms of temperature, and unfailingly indicates the point of transformation with an accuracy of + or - 5 deg. Author

N72-12470# Lehigh Univ., Bethlehem, Pa. Inst. for Metal Forming.

BEHAVIOR OF HARD PARTICLES IN METAL DURING PLASTIC DEFORMATION

Eliezer Rozovsky and W. C. Hahn [1970] 184 p refs

(Contract AT(30-1)-4078)

(NYO-4078-4) Avail: NTIS

The applicability of the upper bound approach to explain deformation patterns of a soft metallic matrix around hard microscopic particles was examined experimentally. Six factors involving the deformation process were investigated: (1) geometrical shape of the particle, (2) spacing between the particles, (3) the ratio a = particle yield stress/matrix yield stress, (4) environmental pressure, (5) void formation, and (6)

particle matrix bond. The deformation experiments were carried out by hydrostatic extrusion of split billets and tensile tests of sound billets in the atmosphere. It is concluded that weak bonds between the particle and the matrix cause initiation and growth of voids around the particle at low strains, and these voids stabilize upon subsequent strain, provided the environmental pressure does not drop. Author

N72-12471# California Univ., Livermore. Lawrence Radiation Lab.
INTERNAL NITRIDING OF Mo-Hf ALLOYS
James S. Kane 22 Mar. 1971 14 p refs Presented at the 7th Plansee Seminar on Powder Met. of High Temp. Mater., Ruette, Austria, 21-25 Jun. 1971 Sponsored by AEC
(UCRL-73100; Conf-710602-1) Avail: NTIS

The investigation of the strengthening of a molybdenum-base alloy by internal nitriding is summarized. The material tested was a 0.050-in.-thick Mo-1 at. percent Hf alloy, nitrided by the inward diffusion of nitrogen. The alloy was tested at 1100 to 1500 C for both short and long time mechanical properties. In addition the microstructure was examined extensively. The high-temperature mechanical properties of the nitrided alloy were found to be greatly superior to the properties of commercial, thermomechanically processed alloys. The strength is due to the precipitated HfN, whose morphology is well suited for imparting strength through coherency strain. In general, the strength is improved by small precipitate size and close spacing. These properties can be controlled by a correct choice of Hf concentration, temperature of nitriding, and nitrogen pressure.
Author (NSA)

N72-12472# Naval Air Development Center, Johnsville, Pa. Aero Materials Dept.
FATIGUE EVALUATION OF THE X7050 ALUMINUM ALLOY
Joseph Viglione 22 Jun. 1971 15 p refs
(AD-725839; NADC-MA-7133) Avail: NTIS CSCL 11/6

A fatigue evaluation was conducted to determine the relative tension-tension fatigue properties of the recently developed X7050 (MA15) aluminum alloy as compared to those of the established commercial 7075 and 7079 aluminum alloys. It was ascertained that the X7050 aluminum alloy had a fatigue strength at the 10 cycle life that was approximately 18% and 54% greater than the fatigue strength of the 7075 and 7079 aluminum alloys, respectively. Author (GRA)

N72-12473# Lockheed-Georgia Co., Marietta.
MECHANISM OF SUPERPLASTICITY IN Al-78 PERCENT Zn ALLOY Summary Technical Report, 20 Jun. 1967 - 30 Jun. 1971
Ervin E. Underwood, Eun U. Lee, and Harvard H. Kranzlein 30 Jun. 1971 91 p refs
(Contract N00014-67-C-0503)
(AD-725864) Avail: NTIS CSCL 11/6

Superplasticity in the Al-78% Zn eutectoid alloy requires a fine-grain, equiaxed microstructure, deformation at temperatures just below the eutectoid temperature, and a strain rate of approximately 0.2/min. An extremely large amount of neck-free elongation is obtained without significant grain growth or change in grain shape. The primary deformation mechanism is attributed to grain sliding and grain rotation at phase boundaries in conjunction with crystallographic deformation and dynamic recovery. A diffusion-controlled accommodation process must operate to preserve the fit at phase boundaries. These conclusions are based largely on our experimental observations, as well as on recent reports in the literature that tend to support this view. Author (GRA)

N72-12474# Clapp (William F.) Labs., Inc., Duxbury, Mass.
ANAEROBIC BACTERIAL CORROSION OF METAL IN SEA WATER AT ELEVATED HYDROSTATIC PRESSURES Final Report, 1 May 1968 - 31 May 1971
Charles A. Willingham 31 Jul. 1971 30 p refs
(Contract N00014-68-C-0365)
(AD-727221; Rept-14254; NR-137-770) Avail: NTIS CSCL 11/6

The effects of hydrostatic pressures on the anaerobic corrosion of ingot iron, E.C. Grade aluminum, and 316-type stainless steel by three marine sulfate-reducing bacterial cultures were examined. Depending upon the period of exposure, all three cultures were capable of producing a greater amount of iron corrosion at 200 atmospheres than at one atmosphere. At 20 C, all cultures were sterilized by a hydrostatic pressure of 600 atmospheres, although incubation of one culture (BS-1) at 40 degrees allowed limited growth and corrosion of iron at this pressure. Increase in the amount of available nutrient medium in a compatable pressure system produced a significant increase in the corrosion of iron. Weight loss of aluminum and stainless steel specimens was little affected by the presence of a bacterial system. Aggressiveness of all three cultures to iron at one and 200 atmospheres when molecular hydrogen was present in the bacterial/metal system was significantly reduced. Little change in any corrosion of aluminum or stainless steel was noted when also exposed to a system with hydrogen. Interaction of the hydrogen present in the culture medium with the iron surface to produce sufficient atomic hydrogen for bacterial metabolism was indicated as the cause of unusually low corrosion rates but good bacterial growth. Type of corrosion attack on iron was most often uniform; when corrosion of aluminum or stainless steel occurred, attack was a shallow, pitting type. No intergranular cracking type of corrosion was observed. Author (GRA)

N72-12475# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
THE DISLOCATION CELL SIZE AND DISLOCATION DENSITY IN COPPER DEFORMED AT TEMPERATURES BETWEEN 25 AND 700 DEG C
Michael R. Staker and David L. Holt Jun. 1971 41 p refs
(Contract N00014-67-A-0204-0039; Proj. NR-031-741)
(AD-726207; TR-3) Avail: NTIS CSCL 11/6

A dislocation cell structure was developed in polycrystalline OFHC copper by deforming tensile specimens 10 percent, one at each of the following temperatures: 25, 250, 400, 500, 550, 600, 650 and 700C. The dislocation cell size and the dislocation density were measured by transmission electron microscopy. The mean cell diameter increased with increasing temperature from 1.4 micrometers at 25C to 6.0 micrometers at 700C. The dislocation density rho decreased with increasing temperature, from 118.0 x 10 to the 8th power cm/cc at 25C to 10 to the 8th power cm/cc at 700C. The thickness of the cell walls decreased with increasing temperature of deformation. it was found that the mean cell diameter d was related to the dislocation density rho through the relation d = 16.2 rho to the -1/2 power. The occurrence of such a relation supports a theory in the literature of dislocation cell formation. The flow stress tau was given by tau = 10.5 Gb/d and tau = .575 Gb rho to the 1/2 power where G is the shear modulus and b is the Burgers vector. Author (GRA)

N72-12476# TRW Equipment Labs., Cleveland, Ohio. Materials Technology Dept.
A COMPARISON OF HYDROGEN EMBRITTLEMENT AND STRESS CORROSION CRACKING IN HIGH STRENGTH STEELS
C. S. Kortovich and E. A. Steigerwald 15 Jun. 1971 33 p refs
(Contract N00014-69-C-0286)
(AD-726192; ER-7530) Avail: NTIS CSCL 11/6

The purpose of the study was to compare the known behavior of hydrogen embrittled high-strength steel to the characteristics of environmentally-induced stress corrosion failure where hydrogen is continuously generated at the specimen surface. The incubation time for the initiation of slow crack growth was accelerated by prestressing for a fixed time below the lower critical limit. These results obtained on high-strength steel in a stress corrosion environment were directly comparable to behavior of hydrogenated specimens. These data along with

hydrogen diffusivity measurements and the insensitivity of the incubation time and crack growth rate to specimen thickness indicated that the stress corrosion process was controlled by the distilled water-metal surface reaction. Author (GRA)

N72-12477# Catholic Univ. of America, Washington, D.C. Dept. of Ocean Science and Engineering.
ON THE SELECTION OF MODELING MATERIALS TO SCALE LONG TERM EROSION BEHAVIOR OF PROTOTYPE SYSTEMS
A. Thiruvengadam Jan. 1971 39 p refs
(Contract N00014-67-A-0377-0008; NR Proj. 062-436)
(AD-726205; Rept-71-1) Avail: NTIS CSCL 11/6

Attempts are now being made to develop modeling techniques to scale the intensity of erosion in the laboratory. The paper deals with the quantitative aspects of the selection of modeling materials. The major problem is the relationship between the rate of erosion and the exposure time. The erosion rate-exposure time relationships for a spectrum of materials are correlated with a recently developed theory of erosion. This approach shows how one could relate model-prototype materials quantitatively. Practical feasibility and limitations are also discussed. Author (GRA)

N72-12478# Dayton Univ. Research Inst., Ohio.
AN INVESTIGATION OF VERY HIGH SPEED DROP IMPINGEMENT EROSION OF 1100 ALUMINUM Technical Report, Jun. 1970 - Feb. 1971
Olive G. Engel Wright-Patterson AFB, Ohio AFML May 1971 50 p refs
(Contract F33615-69-C-1385; AF Proj. 7340)
(AD-728654; AFML-TR-71-104) Avail: NTIS CSCL 11/6

An investigation of five available specimens of 1100-0 aluminum, which were tested under waterdrop impingement at velocities from Mach 1.5 to Mach 4, was undertaken to determine the mechanism of erosion of aluminum at very high velocities. The results of inspection of the eroded specimens with use of a light microscope and scanning electron microscope revealed that plastic flow of the aluminum increased as the test velocity increased. Cross-sectional cuts of the specimens revealed a small amount of work-hardening at velocities of Mach 2.5 and above, but no evidence of crack formation was found. These findings are compatible if the heat generated by the amount of plastic flow of aluminum that occurs is large enough to anneal the worked metal. If this is the case, aluminum is a permanently plastic material. Two mechanisms of metal removal are considered. The first, which is applicable at velocities up to Mach 2.5, is the breaking off of proturberances formed by plastic flow of the metal. The second, which is applicable at velocities above Mach 2.5, is the extrusion of separate masses of metal which have become surrounded by surfaces of discontinuity as a result of the pummeling effect of the individual waterdrop blows. The second mechanism of metal loss can be expected to progress as a layer-removal process. Author (GRA)

N72-12479# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
MECHANISMS OF FATIGUE CRACK PROPAGATION IN ALUMINUM ALLOYS Final Report, Jan. 1969 - Mar. 1971
K. Erhardt, A. Wilson, R. M. N. Pelloux, and N. J. Grant Wright-Patterson AFB, Ohio AFML May 1971 74 p refs
(Contract F33615-67-C-1441; AF Proj. 7351)
(AD-728659; AFML-TR-71-109; Task-735106) Avail: NTIS CSCL 11/6

The mechanisms of crack initiation and propagation in fatigue and of crack propagation under a monotonic load were studied in high strength aluminum alloys. Part I is a detailed report on the use of scanning electron microscopy in fatigue crack propagation research. The results are discussed with reference to the theories of fatigue crack propagation. Part II is a documentation of crack initiation and stage I fatigue fracture in aluminum alloys. The existence of non-propagating cracks in aluminum alloys is discussed by comparing the endurance limit and the stress intensity threshold for non-propagating fatigue cracks. Part III reports the influence of temperature and cyclic rate on crack growth in 2024 T3 aluminum alloy. Part IV deals with the role of the cold work of the plastic zone at the tip of a crack on the mechanisms of fatigue crack growth rate. Part V is a study of the correlation between the fracture toughness index K and the tensile properties. This work was undertaken to understand the dependance of the critical stress intensity factor on aging, the workhardening exponent, and plane strain ductility. Author (GRA)

N72-12480# Army Foreign Science and Technology Center, Charlottesville, Va.
RECRYSTALLATION OF HETEROGENEOUS Al-Cu ALLOYS
A. F. Polesya and V. M. Pasalskii 21 Jul. 1971 14 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (Moscow), v. 28, no. 4, 1969 p 661-667
(AD-728655; FSTC-HT-23-532-71) Avail: NTIS CSCL 11/6

The influence of the type of segregation and degree of their dispersion on the kinetics of recrystallization of the cold rolled alloy A1-4.5 wt percent cu is studied at 330 C. In order to produce varying degrees of dispersion of segregations, freshly hardened specimens before cold rolling were annealed for various periods of time at the recrystallization temperature. It was established that the increase in the time of beginning and completion of recrystallization occurs when pre-aged alloys contain plates of the metastable theta prime phase, coherently bonded to the lattice of the matrix. Curves of the change in the period of the crystalline lattice, specific electrical resistance and microhardness of specimens which have undergone various types of heat treatment in the process of recrystallization are produced. The structure of the alloy is studied by an electron microscope method. Author (GRA)

N72-12481# Naval Research Lab., Washington, D.C.
CRACK PROPAGATION IN ALUMINUM ALLOYS UNDER HIGH AMPLITUDE CYCLIC LOAD
T. W. Crooker 12 Jul. 1971 20 p refs
(NRL Proj. M01-25; RR Proj. 007-01-46-5432)
(AD-728385; NRL-7286) Avail: NTIS CSCL 11/6

Crack propagation studies were conducted on a variety of structural aluminum alloys under high stress-intensity amplitude cyclic load (delta K = 10 ksi square root of in.). The alloys under investigation included 2219-T87, 5456-H321, 6061-T651, 7005-T63, 7039-T6X31, and 7106-T63. The yield strengths of these alloys ranged from 34 to 55 ksi. Tests were conducted in ambient room air and in 3.5-percent NaCl saltwater environments. Data are presented on log-log coordinates in terms of fatigue crack growth rate (da/dN) as a function of the stress-intensity factor range (delta K). Author (GRA)

N72-12482# General Motors Corp., Indianapolis, Ind. Diesel Allison Div.
DEVELOPMENT OF TITANIUM ALLOYS FOR CAST GAS TURBINE ENGINE COMPONENTS Final Report, 15 Jun. 1969 - 14 Jan. 1971
U. Hellmann and T. C. Tsareff Wright-Patterson AFB, Ohio AFML Jul. 1971 95 p refs
(Contract F33615-69-C-1608; AF Proj. 7351)
(AD-728225; DDAD-EDR-7035; AFML-TR-71-47; Task-735105) Avail: NTIS CSCL 11/6

A two phase problem definition program was conducted to determine the need for development of titanium alloys for casting high speed rotating components, e.g., compressor impellers. (U) Four commercially available alloys, Ti-6A1-4V, 5621S, IM1700 and Beta III were appraised with respect to castability and end-item casting performance potential. Phase 1 screening studies involved casting a stylized shape in refractory metal face coated ceramic shell molds by skull melting and bottom pour induction melting. Castings were subjected to non-destructive inspection, and after appropriate heat treatment, to tensile, high cycle reverse bending fatigue, ballistic impact and metallographic tests. On the basis of tensile and fatigue test

data, Ti-6A1-4V alloy was considered the optimum alloy for high speed rotating component application. This alloy was further evaluated in Phase 2 via low cycle fatigue tests of skull melted stylized castings. In addition, tensile properties and destructive spin test behavior were determined for skull melted compressor impeller castings of T63 engine configuration. Ceramic molds were instrumented in an attempt to correlate cooling curves with microstructure and mechanical properties. It was concluded that castability of the alloys evaluated is essentially identical, and that there is no apparent need to develop new alloys for the purpose of producing complex titanium castings for visualized high speed rotating component applications. Author (GRA)

N72-12483# Midwest Research Inst., Kansas City, Mo.
MECHANISMS OF FATIGUE IN MILL-ANNEALED Ti-6Al-4V AT ROOM TEMPERATURE AND 600 F Technical Report, 1 Apr. 1970 - 28 Feb. 1971
David K. Benson, J. Charles Grosskreutz, and Gordon G. Shaw
Wright-Patterson AFB, Ohio AMFL Apr. 1971 52 p refs
(Contracts F33615-70-C-1284; F33615-67-C-1547; AF Proj. 7353)
(AD-728239; AFML-TR-71-81; BPSN-64-6805-7353-735303; Task-735303) Avail: NTIS CSCL 11/6

The mechanisms of the fatigue of mill-annealed Ti-6Al-4V were studied at 600 F and room temperature. Early crack initiation (N sub o approximately = or < 0.14 Nf) was found to occur in HCP alpha-grains by a slip-band mechanism under all but the least severe conditions of cyclic stress. Under stresses near the fatigue limit at room temperature, fatigue cracks began much later at the interface between HCP alpha- and BCC beta-grains without detectable slip. Under all conditions, Stage 1 fatigue crack growth occupied 50-80% of the total life. Although mechanical twins were produced in profusion near the growing Stage 2 fatigue cracks, they appeared to play no role in crack initiation or Stage 1 crack growth, nor did they facilitate Stage 2 growth. A very thin polygonized layer (approximately 1 micrometer thick) was discovered adjacent to the Stage 2 fatigue crack surfaces. Author (GRA)

N72-12484# Army Foreign Science and Technology Center, Charlottesville, Va.
THE STRUCTURE AND PROPERTIES OF TYPE KhN 60 NBTYu (EP 487) ALLOY
L. N. Zemina, G. F. Kosheleva, B. A. Karbonov, and V. K. Tsvetkova 4 Nov. 1970 14 p refs Transl. into ENGLISH from the monograph Stryaktyara i Svoistva Splava Marki KhN60 MVTYU EP 487, Struktura i Svoistva Zharoprochnykh Metallicheskikh Materialov, 1967
(AD-728310; FSTC-HT-23-429-70) Avail: NTIS CSCL 11/6

The development of a new weldable, heat resistant alloy Type EP 487 with a nickel-chromium base is discussed. The alloy process improved mechanical properties in comparison to the currently employed EP 202 alloy. The maximum hardening of the new alloy was obtained during the aging process at temperatures of 800-850 C. Author (GRA)

N72-12485# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF POROUS BERYLLIUM BY THE HOT ISOSTATIC PRESSING OF PLASMA SPHEROIDIZED POWDER Final Technical Report, 1 Jun. 1969 - 15 Dec. 1970
Edward O. Speidel Apr. 1971 61 p refs
(Contract F33615-69-C-1648; AF Proj. 7351)
(AD-728234; AFML-TR-71-73) Avail: NTIS CSCL 11/6

Spheroidal beryllium powder in the nominal 40 to 50-micron size range was prepared from irregular starting material by plasma spheroidization. An effort was made to develop hot-isostatic-pressing parameters necessary to reproducibly fabricate porous beryllium billets from this powder possessing uniform permeabilities of 0.1, 0.01, and 0.001 darcy plus or minus 10 percent. In the program, no billets were produced to the specified permeability of 0.1, 0.01, or 0.001 darcy plus or minus 10 percent. Only one full-size billet, having a permeability of 0.017 darcy, was within the range of 0.1 to 0.001 darcy. Reproducibility of the process was not established in this range as a second billet produced under identical conditions had a similar density but its permeability could not be determined. Data from billets outside the specified permeability range indicated that hot isostatic pressing of spherical powders has potential for the reproducible fabrication of porous beryllium billets as well as for achieving uniformity of permeability within the billets. However, development of a process to produce spherical powder in reasonable quantity would be required. The tensile strength, compressive strength, and modulus of rupture decreased linearly with decreasing density. Anticipated values of these properties, based on extrapolation, for permeabilities within the range of 0.1 to 0.001 darcy would be 5 to 15 x 1000 psi, 20 to 45 x 1000 psi, and 10 to 25 x 1000 psi, respectively.
Author (GRA)

N72-12486# Massachusetts Inst. of Tech., Cambridge. Center for Materials Science and Engineering.
STRUCTURE AND PROPERTY CONTROL THROUGH RAPID QUENCHING OF LIQUID METALS Semiannual Technical Report, 1 Jan. - 30 Jun. 1971
Nicholas J. Grant, Regis M. N. Pelloux, Merton C. Flemings, and Ali S. Argon 1 Jul. 1971 192 p refs
(Contract DAHC15-70-C-0283; ARPA Order 1608; ARPA Proj. 0D10)
(AD-728053; SATR-2) Avail: NTIS CSCL 11/6

The report presents the results and accomplishments of the first year of a three year research program investigating the production of solid bars from rapidly quenched liquid metals. Steam atomization was used to prepare coarse metal powders of a maraging steel VM 300, a nickel base alloy IN100 and cobalt base alloys. This atomization process can be used successfully with cobalt base alloys but does not appear to be suitable for the nickel base alloys. Improvments will have to be made to control the chemistry and the purity of the maraging steel coarse powders produced by steam atomization. Billets and solid bars were produced by hot isostatic compaction, or by extrusion of coarse powders. The bond strength between metal powder particles prior to cold or hot working of the compacted bars is strongly dependent upon the presence of impurities such as oxygen, hydrogen and carbon. Hot isostatic compaction followed by extrusion gave the best results in terms of mechanical properties and homogeneity of the billets. The influence of cooling environments and cooling rates on the secondary dendrite arm spacing and the extent of microsegregation within the coarse powder particles was studied in detail. The mechanical properties and the microstructures of the different alloys produced by the powder process are reported and compared to the properties of the commercially cast and wrought alloys having the same chemistry. Author (GRA)

N72-12487# Army Foreign Science and Technology Center, Charlottesville, Va.
KINETICS OF DEVELOPMENT OF CRACKS WITH CYCLICAL SOFTENING
N. A. Makhutov 21 Jul. 1971 14 p refs Transl. into ENGLISH from the monograph Kinetika Razvitiya Treshchin pri Tsiklicheskom Razuprochnenii, Prochnost pri Malom Chisle Tsiklov Nagruzheniya, Moscow, 1969 p 102-109
(AD-728530; FSTC-HT-23-512-71) Avail: NTIS CSCL 11/6

Cyclically softening low-alloy steel was studied in fatigue tests using flat and cylindrical specimens, notched and smooth.
Author (GRA)

N72-12488# Army Foreign Science and Technology Center, Charlottesville, Va.
DUCTILITY AND STRENGTH OF METALS UNDER COMPLEX STRESS CONDITIONS
L. Z. Grebnev 21 Jul. 1971 11 p refs Transl. into ENGLISH from Prikl. Mekh., Akad. Nauk Ukr SSR (Kiev), v. 6, no. 2, 1970 p 120-124
(AD-728229; FSTC-HT-23-733-71; T7023012301) Avail: NTIS

CSCL 11/6

A study is presented of the influence of the stress state on ductility and strength of thinwall tubular specimens of nickel and copper under proportional loading conditions. Author (GRA)

N72-12501# Battelle Inst., Frankfurt am Main (West Germany).
DISCUSSION OF STEEL-WIRE-REINFORCED ALUMINUM ALLOYS INVESTIGATED AT BATTELLE-INSTITUT e.V., FRANKFURT-AM-MAIN
U. Seidelmann *In* AGARD Composite Mater. Sep. 1971 4 p refs (See N72-12492 03-18)
Avail: NTIS

N72-12502# Atomic Weapons Research Establishment, Foulness (England).
STRENGTHENING OF ALUMINUM BY EXPLOSIVE INCORPORATION OF BERYLLIUM WIRES
C. V. Jarvis and P. M. B. Slate *In* AGARD Composite Mater. Sep. 1971 19 p refs (See N72-12492 03-18)
Avail: NTIS

N72-12503# Groupe Pechiney, Voreppe (France). Groupe Pechiney
PRODUCTION OF ALUMINUM-BERYLLIUM COMPOSITES BY HOT PRESSING [REALISATION DE COMPOSITES ALUMINUM-BERYLLIUM PAR PRESSAGE A CHAUD]
R. Cousserans *In* AGARD Composite Mater. Sep. 1971 6 p In FRENCH (See N72-12492 03-18)
Avail: NTIS

N72-12504# Midwest Research Inst., Kansas City, Mo. Center for Applied Research on Materials.
MECHANISMS OF FATIGUE IN FILAMENT-REINFORCED METALS
J. R. Hancock *In* AGARD Composite Mater. Sep. 1971 21 p refs Sponsored in part by AFML (See N72-12492 03-18)
Avail: NTIS

N72-12507# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
STUDY OF INTERACTION BETWEEN A BERYLLIUM FIBER AND AN ALUMINUM MATRIX [ETUDE DE L'INTERACTION ENTRE UN FIL DE BERYLLIUM ET UNE MATRICE ALUMINIUM]
J. P. Trottier and R. Graf *In* AGARD Composite Mater. Sep. 1971 9 p refs In FRENCH; ENGLISH summary (See N72-12492 03-18)
Avail: NTIS

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N72-12489 Washington Univ., Seattle.
THE BRITTLE FRACTURE OF THERMOPLASTIC POLYMERS AND COMPOSITES Ph.D. Thesis
Kenneth Lee Trachte 1970 288 p
Avail: Univ. Microfilms Order No. 70-18956

The brittle fracture properties of unfilled polyphenylene oxide, polysulfone, polycarbonate, polymethylmethacrylate, glass bead filled polyphenylene oxide, short random glass fiber filled polyphenylene oxide, and short random graphite fiber filled polyphenylene oxide were investigated. The variables were testing temperature, filler concentration, filler geometry, filler properties, and adhesion of polymer to the filler. Fracture energy measurements were taken using double edge-notched tensile samples. Tensile strength, tensile strain, and initial elastic modulus were measured for use in calculation of the fracture energy. An overall brittle fracture analysis of each material was presented, considering the fracture energy, tensile strength, tensile strain, and initial elastic modulus values. Dissert. Abstr.

N72-12490 National Lending Library for Science and Technology, Boston Spa (England).
CALCULATING THE STRENGTH OF GLASS FIBRE-PLASTIC LAMINATES UNDER COMBINED LOAD (HYPOTHESES, AND LAYERWISE ANALYSIS, OF FRACTURE)
A. Puck 7 Sep. 1971 30 p Transl. into ENGLISH from Kunststoffe, v. 59, no. 11, 1969 p 780-787 Supported by Arbeitsgemeinschaft Industrieller Forschungsvereinigungen (Assoc. for Ind. Res. Organ.) "Otto von Guericke"
(NLL-LB/G/3079-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

Laminates in structural components made of glass-fiber-reinforced plastics are mainly used under complex loading. When calculating the strength of a structural component under a combined load, from strength data obtained for sample specimens, it is usual to operate with fracture hypotheses. Fracture conditions are represented by arbitrary functions which are common to a number of test specimens. The layerwise fracture analysis is discussed, and data are given for the material strength under combined loads which approximate actual conditions. In addition, the analysis offers more information on deformation and the nature and location of a failure (cracking between fibers and fiber rupture). The laminate is replaced, in the calculation, by a multilayered composite of unidirectional systems. Author

N72-12491 National Lending Library for Science and Technology, Boston Spa (England).
THERMAL OXIDATION AS A METHOD OF GETTING HIGH PURITY SiO2 LAYERS
J. Ryszko and J. Zak 19 Aug. 1971 6 p refs Transl. into ENGLISH from Elektronika (Poland), no. 2, 1971 p 62-64
(NLL-PORS-Trans-2787-(9022.81)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A new method of oxidation has been developed for the production of high purity silicon dioxide layers. The oxidation process takes place in a resistance furnace in a double walled quartz pipe. A current of nitrogen passes beween the walls during oxidation and forms a protective nitrogen coating which prevents the penetration of impurities through the walls of the pipe. The silicon dioxide layers obtained had good insulation properties and low surface charge densities on the order of 10 to the 11th power charge/sq cm. A.L.

N72-12492# Advisory Group for Aerospace Research and Development, Paris (France).
COMPOSITE MATERIALS
Sep. 1971 225 p refs Partly in ENGLISH; partly in FRENCH Conf. held at Paris, 2-3 Apr. 1970
(AGARD-CP-63-71; AGARD-CONF-Proc-63) Avail: NTIS

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6. MECHANICAL PROPERTIES OF EPOXY-SILICA COMPOSITE MATERIALS P. DeMeester, P. Dambre, and

A. Deruyttere (Louvain Univ., Belgium) 11 p refs (See N72-12493 03-18)

7. THE NPL ULTRASONIC TANK: ITS USES IN POLYMER AND FIBRE COMPOSITE TESTING M. F. Markham (Natl. Physical Lab., Teddington, England) 8 p refs (See N72-12494 03-11)

8. MODULUS OF ELASTICITY MEASUREMENTS ON RESIN FIBER COMPOSITES H. Guyot and M. Bediard (Office Natl. D'Etudes et de Rech. Aerospatiales) 13 p refs (See N72-12495 03-18)

9. LINEAR AND NONLINEAR CHARACTERISTICS OF A UNIDIRECTIONAL EPOXY-SILICON REINFORCED COMPOSITE J. Pabiot (Centre D'Etude des Matieres Plastiques, Paris, France) 15 p refs (See N72-12496 03-18)

10. ELASTIC CONSTANTS EVALUATION OF A REINFORCED PLASTIC MATERIAL A. Bracco, G. Mannone, and M. Sattin (Fiat S.P.A., Turin, Italy) 24 p refs (See N72-12497 03-18)

11. ELASTIC CHARACTERIZATION OF FIBER REINFORCED COMPOSITES J. M. Slepetz (Army Mater. and Mechanics Res. Center, Watertown, Mass.) 10 p refs (See N72-12498 03-18)

12. MECHANICAL BEHAVIOR OF SiO2-EPOXY COMPOSITE F. Darwish and A. S. Tetelman (Calif. Univ., Los Angeles) 7 p refs (See N72-12499 03-18)

13. DETERMINATION OF MATRIX AND FILAMENT STRESS-STRAIN PROPERTIES FROM TESTS MADE ON COMPOSITES R. Papirno and J. Slepetz (Army Mater. and Mechanics Res. Center, Watertown, Mass.) 4 p refs (See N72-12500 03-18)

14. DISCUSSION OF STEEL-WIRE-REINFORCED ALUMINUM ALLOYS INVESTIGATED AT BATELLE-INSTITUT e.V., FRANKFURT-AM-MAIN U. Seidelmann (Battelle Inst., Frankfurt AN Main, West Ger.) 4 p refs (See N72-12501 03-17)

15. STRENGTHENING OF ALUMINIUM BY EXPLOSIVE INCORPORATION OF BERYLLIUM WIRES C. V. Jarvis and P. M. B. Slate (Atomic Weapons Res. Estab., Foulness, England) 19 p refs (See N72-12502 03-17)

16. PRODUCTION OF ALUMINUM-BERYLLIUM COMPOSITES BY HOT PRESSING R. Cousserans (Groupe Pechiney, Voreppe (France)) 6 p (See N72-12503 03-17)

17. MECHANISMS OF FATIGUE IN FILAMENT-REINFORCED METALS J. R. Hancock (Midwest Res. Inst., Kansas City, Mo.) 21 p refs (See N72-12504 03-17)

18. A NEW TEST FOR THE GLASS-TO-RESIN BOND LIFE IN GRP: COMPARISON OF TYPICAL SYSTEMS EXPOSED TO WATER M. H. Stone (Rubber and Plastics Res. Assoc. of Great Britain 12 p refs (See N72-12505 03-18)

19. WETTING AND TREATMENT OF REINFORCING FIBER FILAMENTS FOR ORGANIC MATERIALS G. Mavel (Inst. de Rech. de Chimie Avancee, Paris, France) 9 p refs (See N72-12506 03-18)

20. STUDY OF INTERACTION BETWEEN A BERYLLIUM FIBER AND AN ALUMINUM MATRIX J. P. Trottier and R. Graf (Office Natl. D'Etudes et de Rech. Aerospatiales, Paris, France) 9 p refs (See N72-12507 03-17)

21. CALCULATING AND PREDICTING VISCOELASTIC CONSTANTS OF COMPOSITE MATERIALS N. P. Vinh Toung (Inst. Superieur des Materiaux et de la Cons.) 28 p refs (See N72-12508 03-18)

22. REMARQUES AU SYMPOSIUM SUR LES MATERIAUX COMPOSITES J. Lemaitre 2 p

23. REMARQUES AU SYMPOSIUM SUR LES MATERIAUX COMPOSITE DE L'AGARD J. Pabiot 2 p

24. DEVELOPPEMENT EVENTUEL DU PROGRAMME G. Dixmier 2 p

25. APPENDIX: DISCUSSIONS ON PRESENTED PAPERS 8 p

N72-12493# Louvain Univ. (Belgium). Inst. voor Metaalkunde.
MECHANICAL PROPERTIES OF EPOXY-SILICA COMPOSITE MATERIALS
P. deMeester, P. Dambre, and A. Deruyttere *In* AGARD Composite Mater. Sep. 1971 11 p refs (See N72-12492 03-18)
Avail: NTIS

Composite materials, consisting of an epoxy matrix, longitudinally reinforced by oriented silica fibres, have been tested for their mechanical properties. Primarily the elastic coefficients have been measured. For this purpose static and dynamic measurements have been performed. Specimen forms and test results are discussed. Other mechanical properties (U.T.S.) are also presented and discussed in view of the application of such fibre reinforced materials as structural elements. Author

N72-12494# National Physical Lab., Teddington (England). Div. of Molecular Science.
THE NPL UTRASONIC TANK: ITS USES IN POLYMER AND FIBRE COMPOSITE TESTING c11
M. F. Markham *In* AGARD Composite Mater. Sep. 1971 8 p refs (See N72-12492 03-18)
Avail: NTIS

Measurement of ultrasonic attenuation on composites has been shown to be a valuable qualitative method of testing these materials for voids or similar defects. Existence of these does seriously reduce the strength and indeed the elastic constants. It is therefore highly desirable that all samples are tested in this manner before further tests are carried out. The method has been applied to two composites, silica-epoxy and silica-phenolic sheets. Values of their elastic constants are given in the appendix. Author

N72-12495# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
MODULUS OF ELASTICITY MEASUREMENTS ON RESIN FIBER COMPOSITES [MESURES DE MODULES ELASTIQUES SUR COMPOSITE FILS-RESINE]
H. Guyot and M. Hediard *In* AGARD Composite Mater. Sep. 1971 13 p refs In FRENCH; ENGLISH summary (See N72-12492 03-18)
Avail: NTIS

Test specimen have a rectangular section of 4 x 10 mm. Elastic deformations are measured under a rather low stress. Three extensometers are mounted together to measure the variations of total width, of total thickness, and the deformation stress and test specimen lengths. Within one percent, measurements are reproductible when made on the same test specimen of furnished materials. But there is a rather great dispersion between different specimens. Moreover, test specimen stressed perpendicularly to silica yarns show a rather consequential delayed elasticity. Author

N72-12496# Centre d'Etude des Matieres Plastiques, Paris (France).
LINEAR AND NONLINEAR CHARACTERISTICS OF A UNIDIRECTIONAL EPOXY-SILICON REINFORCED COMPOSITE
J. Pabiot *In* AGARD Composite Mater. Sep. 1971 15 p refs In FRENCH; ENGLISH summary (See N72-12492 03-18)
Avail: NTIS

A method for determining independent mechanical characteristics of an epoxy silica composite material, in which the reinforcement is unidirectional, is presented. The material takes the form of small dimension sheets. Its characteristics must allow the quantitative response prediction to all states of stress. In the linear domain the compliance-tensor, and in the non-linear domain, a criterion of breaking strength is defined theoretically. The validity of the hypotheses and results have been confirmed by submitting the characteristics as a function of the angular position of the axes. The discussion of the results concerns chiefly the percentage of fiber, its distribution and the physical appearance of the material resulting from certain stress conditions. Author

N72-12497# Fiat S.p.A., Turin (Italy). Lab. Ricerche e Controlli Auto-Avio.
ELASTIC CONSTANTS EVALUATION OF A REINFORCED

PLASTIC MATERIAL
A. Bracco, G. Mannone, and M. Sattin *In* AGARD Composite Mater. Sep. 1971 24 p refs (See N72-12492 03-18)
Avail: NTIS

A theoretical and experimental analysis has been performed to evaluate the elastic constants of a silica-epoxy composite material. From a theoretical standpoint the material under test has been considered as an homogeneous body and assumed to be isotropic in the plane orthogonal to the fibers direction. Under these assumptions one can show that five independent elastic constants are sufficient to describe the elastic properties of the composite material. The values of these constants have then been plotted versus specific weight and strain rate of the samples, by the use of ad hoc suitable equipments. Author

N72-12498# Army Materials and Mechanics Research Center, Watertown, Mass. Theoretical and Applied Mechanics Research Lab.
ELASTIC CHARACTERIZATION OF FIBER REINFORCED COMPOSITES
J. M. Slepetz *In* AGARD Composite Mater. Sep. 1971 10 p refs (See N72-12492 03-18)
Avail: NTIS

The large scatter in test data observed is consistent with previous experience in fiber reinforced materials. Such variance is usually due, in part, to fabrication variables, variation in constituent properties, and deficiencies in test methods. It also has been suggested that local stress concentrations, particularly in transverse normal and shear tests, affect behavior on the gross scale and account for part of the data spread. The specimens were prepared with most of the fabrication variables eliminated, yet the scatter in test results was still excessive. This suggests that conventional test methods are at fault, or that wide variations in composite properties are intrinsic to this class of materials. In any case, the designers' problem of predicting structural behavior or of specifying required properties of composites is considerably magnified by such uncertainties concerning material properties. Author

N72-12499# California Univ., Los Angeles.
MECHANICAL BEHAVIOR OF SiO2-EPOXY COMPOSITE
F. Darwish and A. S. Tetelman *In* AGARD Composite Mater. Sep. 1971 7 p refs (See N72-12492 03-18)
Avail: NTIS

The effects of temperature and fiber orientation on the load carrying capacity, strength and fracture mode of SiO2-epoxy resin composites have been investigated by means of slow bend and impact tests. Although tough and strong when loaded parallel to its fibers, the composite is shown to be weak and brittle when loaded transversely. The composite exhibited little or no notch sensitivity for notches machined along planes normal to the fibers; whereas for the case of notches machined parallel to the fibers, the composite showed considerable notch sensitivity that depended on the test temperature. Increase in test temperature had the effect of reducing the load carrying capacity of both the notched and unnotched samples in both the slow bend and impact loading. Impact energy values measured for the specimens loaded parallel to their fibers showed a slight decrease with the rise in test temperature. Author

N72-12500# Army Materials and Mechanics Research Center, Watertown, Mass. Theoretical and Applied Mechanics Research Lab.
DETERMINATION OF MATRIX AND FILAMENT STRESS-STRAIN PROPERTIES FROM TESTS MADE ON COMPOSITES
Ralph Papirno and John M. Slepetz *In* AGARD Composite Mater. Sep. 1971 4 p refs (See N72-12492 03-18)
Avail: NTIS

A simple method has been developed for the determination of the effective, in situ, linear and nonlinear stress strain response of the matrix and reinforcement from load-strain measurements made on composites. Two specimens with slightly different but predetermined value volume fractions of reinforcement are tested. An analysis of the load-strain data from the two specimens yields the average for the two specimens of stress-strain data for the reinforcement and for the matrix. It is shown that the method is independent of the shape of the component stress-strain curves and may be applied in the linear and nonlinear regions. General principles of specimen pair design are derived based upon a sensitivity analysis of the method which takes into account the precision of the measuring apparatus and the relative stiffnesses of the components of the composites. Author

N72-12501# Battelle Inst., Frankfurt am Main (West Germany).
DISCUSSION OF STEEL-WIRE-REINFORCED ALUMINUM ALLOYS INVESTIGATED AT BATTELLE-INSTITUT e.V., FRANKFURT-AM-MAIN c17
U. Seidelmann *In* AGARD Composite Mater. Sep. 1971 4 p refs (See N72-12492 03-18)
Avail: NTIS

Results obtained in tensile strength measurements made on steel-wire-reinforced aluminum alloys are presented. Carbon steel wire whose final strength after incorporation in the composite was about 140 plus or minus 10 kg/sq mm, was coated with aluminum alloys and, after hot pressing, first subjected to tensile tests. With filament contents of 20 to 60 volume percent increases in strength of 200 to 350 percent were achieved, these values approaching the theoretical values. In dynamic tests on specimens reinforced with 20 volume percent, the strength values measured after 2 x 10 to the seventh power load cycles were 50 percent higher than those of the unreinforced material. Author

N72-12502# Atomic Weapons Research Establishment, Foulness (England).
STRENGTHENING OF ALUMINUM BY EXPLOSIVE INCORPORATION OF BERYLLIUM WIRES c17
C. V. Jarvis and P. M. B. Slate *In* AGARD Composite Mater. Sep. 1971 19 p refs (See N72-12492 03-18)
Avail: NTIS

It is shown that beryllium reinforced aluminum can be prepared using an explosive bonding technique. The mechanical properties of such a composite compare well with those from samples prepared by diffusion bonding. Author

N72-12503# Groupe Pechiney, Voreppe (France). Groupe Pechiney
PRODUCTION OF ALUMINUM-BERYLLIUM COMPOSITES BY HOT PRESSING [REALISATION DE COMPOSITES ALUMINUM-BERYLLIUM PAR PRESSAGE A CHAUD] c17
R. Cousserans *In* AGARD Composite Mater. Sep. 1971 6 p In FRENCH (See N72-12492 03-18)
Avail: NTIS

Hot pressing of beryllium fibers or strips into all aluminum-beryllium composite by a semi-continuous method produced specimens of large dimensions depending on the pressure loads used. A combination hot pressing-laminating procedure produced some difficulties because the fragility of the beryllium and the very important elastic separation between the beryllium and the aluminum alloys caused by the reduction rate necessary to obtain a good fiber matrix compounds.
Transl. by G.G.

N72-12504# Midwest Research Inst., Kansas City, Mo. Center for Applied Research on Materials.
MECHANISMS OF FATIGUE IN FILAMENT-REINFORCED METALS c17
J. R. Hancock *In* AGARD Composite Mater. Sep. 1971 21 p refs Sponsored in part by AFML (See N72-12492 03-18)
Avail: NTIS

The mechanisms of low-cycle fatigue were studied in composites of aluminum reinforced with 34 vol. % of continuous

beryllium filaments. Two series of composite specimens were tested, one series fabricated using as-drawn (rough surfaces) beryllium wire and another using electropolished (smooth surfaces) beryllium wire, to determine the effects of mechanical interlock at the filament-matrix interface on fatigue performance. Axial, strain-controlled fatigue tests were performed. The cyclic stress-strain curves were identical for the two series of composite specimens, while composites reinforced with as-drawn filaments exhibited longer fatigue lives than composites reinforced with electropolished filaments. This difference in fatigue lives between the two series of composites was attributed to the difference in the rate of crack growth parallel to filament-matrix interfaces. It was concluded that rough filament surfaces impede interfacial crack growth. Author

N72-12505# Rubber and Plastics Research Association of Great Britain, Shrewsbury (England).

A NEW TEST FOR THE GLASS-TO-RESIN BOND LIFE IN GRP: COMPARISON OF TYPICAL SYSTEMS EXPOSED TO WATER

M. H. Stone *In* AGARD Composite Mater. Sep. 1971 12 p refs (See N72-12492 03-18)

Avail: NTIS

A new method is described for determining the life of the glass-to-resin bond in GRP exposed to water. The electrical conductance along the strands is measured as a function of time of exposure, and the bond life defined as the time taken for the conductance to attain a certain value. A comparison of several glass/coupling-agent combinations in epoxy resin exposed to boiling water showed a 7-fold range of bond life, with the S-glass/HTS treatment combination giving the most durable bond. Relative bond lives at 60 and 100 C for an E-glass/epoxy composite gave an overall activation energy of about 30 Kcal/mole for the debonding process. Author

N72-12506# Institut de Recherches de Chimie Avancee, Paris (France).

WETTING AND TREATMENT OF REINFORCING FIBER FILAMENTS FOR ORGANIC MATERIALS [MOUILLAGE ET TRAITEMENT DES RENFORCEMENTS FILAMENTAIRES ASSOCIES A DES MATIERES ORGANIQUES]

G. Mavel *In* AGARD Composite Mater. Sep. 1971 9 p refs In FRENCH; ENGLISH summary (See N72-12492 03-18)

Avail: NTIS

A technique for measuring the wetting of a monofilament by the resin itself in a temperature range permissible for the later and all along the hardening process is described. Some insight regarding the preimpregnation mechanism and some characterization of the filament rugosity is provided. Typical results are described for various reinforcements. Author

N72-12507# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

STUDY OF INTERACTION BETWEEN A BERYLLIUM FIBER AND AN ALUMINUM MATRIX [ETUDE DE L'INTERACTION ENTRE UN FIL DE BERYLLIUM ET UNE MATRICE ALUMINIUM] c17

J. P. Trottier and R. Graf *In* AGARD Composite Mater. Sep. 1971 9 p refs In FRENCH; ENGLISH summary (See N72-12492 03-18)

Avail: NTIS

Nickel plated beryllium wires have been covered by an electrolytic aluminium coating, with or without formerly removing the nickel layer. Diffusion phenomena have been studied by X-ray diffraction, scanning microscope examination and microprobe analysis, after a series of thermal treatments of variable duration at 250 deg, 480 deg and 600 C. The recrystallization state of the wires and the matrix has been observed by X-rays. The sample structure does not undergo any noticeable modification at 250 C or for short treatments at 480 C. Author

N72-12508# Institut Superieur des Materiaux et de la Construction Mecanique, Saint-Ouen (France). Lab. d'Automatique et de Mecanique Vibratoire.

CALCULATING AND PREDICTING VISCOELASTIC CONSTANTS OF COMPOSITE MATERIALS [SUR LES CALCULS ET LES PREVISIONS DES CONSTANTES VISCOELASTIQUES DES MATERIAUX COMPOSITES]

N. P. VinhTuong *In* AGARD Composite Mater. Sep. 1971 28 p refs In FRENCH; ENGLISH summary (See N72-12492 03-18)

Avail: NTIS

The theory of elasticity is used in conjunction with the Airy stress function to determine elastic constants of unidirectional fiber reinforced composites by computer programs. In elastodynamics, dispersion relations for the propagation of elastic long waves yield elastic constants in various symmetries. In viscoelasticity, upper and lower bounds are obtained separately. Author

N72-12509# Danish Research Centre for Applied Electronics, Copenhagen.

INTEGRATED CIRCUITS TTL-SSI: AN INVESTIGATION OF 2 PRODUCTS OF THE 54/74 SERIES IN PLASTIC AND CERAMIC PACKAGES [INTEGRERERDE KREDSLOEB, TTL-SSI: EN UNDERSOEGELSE AF 11 FABRIKATER FRA 54/74-SERIEN I PLAST-OG KERAMIKINDKAPSLING]

H. J. Nordby Sep. 1971 69 p refs In DANISH; ENGLISH summary

(ECR-24) Avail: NTIS

The investigation was limited to the small-scale integration group of digital integrated circuits, from which a simple gate and master-slave flip-flop were chosen to illustrate the influence of complexity on reliability. 2800 of each of the two types of components, and distributed by 9 manufacturers of plastic packaged circuits and 5 of ceramic packaged ones were studied. Results show that the various manufacturers have a very divergent quality level. This may be because the components were purchased at the same time and arrived in a single delivery. Ceramic packaging for certain manufacturers appears to be less resistant to humidity than plastic packaging. Otherwise, there is no distinct difference between the two kinds of packaging. Author

N72-12510# Royal Aircraft Establishment, Farnborough (England).

TENSILE TESTS ON TAP-JOINTS IN CARBON FIBRE REINFORCED PLASTICS

J. B. Sturgeon Aug. 1970 27 p refs

(RAE-TR-70159; Mat-112; UDC-661426; UDC-620.172.2)

Avail: NTIS

Results are presented for lap-joints tested in tension for adherends of type 1 and type 2 CFRP (carbon fiber reinforced plastics) and also for type 1 treated carbon fiber laminates with glass scrim cloth facings. The percentage of the unjointed composite load realized in the jointed specimens was sometimes higher than 50% indicating that this type of joint could be suitable for joining CFRP to itself. Author

N72-12511*# Curtiss-Wright Corp., Buffalo, N.Y.

THE DEVELOPMENT AND EVALUATION OF A COBALT BASE OXIDATION RESISTANT DISPERSION STRENGTHENED ALLOY

Keki K. Irani Oct. 1971 120 p refs

(Contract NAS3-11162)

(NASA-CR-72900) Avail: NTIS CSCL 11D

The Co-18Cr-20Ni-4 Vol % ThO2 powders were prepared by a flash drying selective reduction process starting with an aqueous solution of metal salts and colloidal thoria. Powders were consolidated and extruded into rods with a minimum density of 99% of theoretical. Swaging and annealing studies were conducted to determine the conditions that would lead to a product with high stress-rupture strength. The best process yielded a stress-rupture life of 7.2 hours at 10 KSI (69 MN sq m and 2000 F (1094 C). The alloy recrystallized to a duplex

(coarse-fine) structure and thus did not exhibit the desired strength of 3000 hours at 15 KSI (103.5MN/sq m and 2000 F (1094 C). Author

N72-12512*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN PROPERTIES OF RANDOMLY REINFORCED FIBER/RESIN COMPOSITES
C. C. Chamis [1971] 19 p refs Proposed for presentation at the 27th Ann. Conf. of the Soc. of Plastic Ind., Inc., Washington, D.C., 8-11 Feb. 1972
(NASA-TM-X-67948; E-6569) Avail: NTIS CSCL 11I

The pseudoisotropic laminate analogy is used in conjunction with fiber composite micro and macromechanics to predict the thermal and mechanical properties of planar randomly reinforced fiber composites (PRRFC). Theoretical results are presented for boron/epoxy, Thornel-50/epoxy, and S-glass/epoxy PRRFC. The results show that the thermal and elastic properties depend on both constituent materials and the fiber volume ratio. The strength depends also on the type of applied stress. Author

N72-12513*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
BASIC FAILURE MECHANISMS IN ADVANCED COMPOSITES Progress Report, May - Oct. 1971
J. V. Mullin, V. F. Mazzio, and R. L. Mehan Oct. 1971 73 p refs
(Contract NASw-2093)
(NASA-CR-124645; PR-2420-N03) Avail: NTIS CSCL 11D

Fundamental failure mechanisms in carbon-epoxy composites were studied for more reliable prediction of the performance of these materials. Single and multiple fiber specimens were tested under tensile loads, and the sequence of failure events was observed. Parameters such as resin crack sensitivity, fiber surface treatment and variations in fibers from batch to batch are being evaluated. The analysis of bulk composite fracture processes using acoustic emission techniques is being studied in order to correlate microscopic observations with bulk composite behavior. Control of the fracture process through matrix and interface modification is being attempted, and study of failure processes in composite/metal specimens is being conducted. Most of the studies involved DEN 438 epoxy novolac as the matrix, but some experiments are now underway using the higher temperature resin ERLA 4617. Author

N72-12514*# Techtran Corp., Glen Burnie, Md.
INVESTIGATIONS OF CEMENTED AND DETACHABLE JOINTS OF FIBER REINFORCED PLASTICS
W. Althof and J. Mueller Washington NASA Dec. 1971 19 p refs Transl. into ENGLISH from Kunststoffe (Munich), v. 60, no. 12, 1970 p 911-916
(Contract NASw-2037)
(NASA-TT-F-14041) Avail: NTIS CSCL 11I

Laminated structures of plastics reinforced with carbon and boron fibers and containing bolt holes were tested for strength under different conditions of fiber orientation, hole diameter, and hole spacing from the edges. Laminates with fiber orientations in 0 and plus or minus 45 deg reach a relatively high bolt hole strength even with relatively small end spacing and should be preferred for aircraft construction. A large number of practical adhesives are suitable for bonding boron fiber reinforced plastic laminates to themselves or to steel and titanium sheeting. Deformable high strength adhesives gave the highest bond strengths. Author

N72-12515*# Denver Research Inst., Colo. Industrial Economics Div.
APPLICATIONS OF AEROSPACE TECHNOLOGY IN INDUSTRY, A TECHNOLOGY TRANSFER PROFILE: PLASTICS
Jul. 1971 77 p refs
(Contract NSR-06-004-063)
(NASA-CR-123419) Avail: NTIS CSCL 11I

New plastics technology bred out of the space program has moved steadily into the U.S. economy in a variety of organized and deliberate ways. Examples are presented of the transfer of plastics know-how into the plants and eventually the products of American business. A.L.

N72-12516*# Scientific Translation Service, Santa Barbara, Calif.
ANODE EFFECT AND GRAPHITE FLUORIDE
Watanabe Nobuatsu and A. Teruaki Washington NASA Dec. 1971 21 p refs Transl. into ENGLISH from Denki Kagaku (Japan), v. 39, no. 2, 1971 p 123-130
(Contract NASw-2035)
(NASA-TT-F-14053) Avail: NTIS CSCL 11D

Research results concerning the anode effect are described. It was concluded that the metal fog connected with the yield depends on the anode effect. For the sake of further improvements and development of the aluminum industry, further research and information will be necessary concerning the anode effect phenomena as well as the electrode reaction mechanism in the anode and cathode. Author

N72-12517# Bendix Corp., Kansas City, Mo.
CONFORMAL COATINGS Quarterly Report, 1971 - 1972
William F. Moyle May 1971 18 p refs
(Contract AT(29-1)-613)
(BDX-613-341) Avail: NTIS

A conformal coating system capable of withstanding 6000 volts in an atmosphere of 1 millimeter mercury for a fireset application was sought. A functional transverter subassembly was operated in a vacuum chamber and subjected to high voltage breakdown tests. Polyurethane coating materials were evaluated. Author

N72-12518# Naval Ordnance Lab., White Oak, Md.
REHARDENING OF EC-2273 POTTING COMPOUND IN F-4 AIRCRAFT ELECTRICAL COMPONENTS Final report, 1 Jul. 1969 - 31 Dec. 1970
Joseph M. Augl and Porter W. Erickson 14 May 1971 23 p refs
(NOLTR Proj. 341/AIR-520C0)
(AD-726180; NOLTR-71-53) Avail: NTIS CSCL 11/9

The useful lifetimes for electrical connectors potted with EC-2273 can be doubled by skin-hardening the surface of the potting compound with a 25% solution of hexamethylene diisocyanate in hexane or with a mixture of hexamethylene diisocyanate, butylisocyanate and hexane. These treatments are applicable to partially deteriorated as well as to the nondeteriorated potting compound. The treatments are carried out simply by immersion of the electrical component in the hardening solution for a period of three days. Author (GRA)

N72-12519# Boeing Co., Seattle, Wash. Aerospace Group.
CONTINUOUS OXIDE FILAMENT SYNTHESIS (DEVITRIFICATION) Final Technical Report, May 1969 - Apr. 1971
Frederick H. Simpson Wright-Patterson AFB, Ohio AFML Jun. 1971 77 p refs
(Contract F33615-69-C-1614; AF Proj. 7350)
(AD-728667; AFML-TR-71-135; Task-735001) Avail: NTIS CSCL 11/5

Studies to produce continuous polycrystalline aluminum oxide filaments by vacuo-thermal conversion of precursor aluminum-boro-phosphate glass filaments are described. A field of compositions in the ternary Al2O3.B2O3.P2O5 system containing up to 60 percent alumina was identified from which glass melts could be produced and filaments drawn. Thoria and yttria additions to the glasses extend their working range and reduce their tendency to devitrify. Macrowarpage and microkinking associated with the thermal conversion were eliminated by tensioning the filaments. Tensile strengths of the filaments produced were approximately one-third of that sought. The

critical factors limiting strength in this region were not associated with grain size or internal porosity, but were likely associated with the nature of the filament surface.
Author (GRA)

N72-12520# Monsanto Research Corp., Dayton, Ohio.
A THERMOPLASTIC TRANSPARENT ADHESIVE FOR BONDING POLYCARBONATE TO GLASS Final Report, 26 Aug. 1970 - 25 Apr. 1971
George L. Ball, III, Philip H. Wilken, Charles J. North, and Ival O. Salyer Jul. 1971 52 p refs
(Contract DAAG46-71-C-0007; DA Proj. 1f1-62205-aa-52)
(AD-728174; MRC-DA-296; AMMRC-CR-71-10) Avail: NTIS CSCL 11/1

The extent of the usefulness of glass and polycarbonate in armored windows depends both on the properties of these two materials, as well as the availability of transparent adhesives for bonding the polycarbonate to glass and to itself. Until now, no completely suitable transparent adhesive of the thermoplastic type has been available. Accordingly, ethylene terpolymers varying in molecular weight, hydroxyl content, and degree of partial crosslinking were investigated. The primary requisities for the adhesive were that it be thermoplastic, optically clear, hydrolytically stable, and maintain the integrity of a glass-polycarbonate laminate when exposed to either thermal cycling from -65 up to &165F or ballistic impact. An ethylene terpolymer material identified as ETA no. 138150 was made available which more than fulfilled the performance requirements.
Author (GRA)

N72-12521# Southern Research Inst., Birmingham, Ala.
DIFFUSIONAL PRESTRESSING OF CERAMICS Summary Report, 15 Oct. 1969 - 14 Oct. 1970
Roy E. Bickelhaupt Dec. 1970 93 p refs
(Contract N00019-70-C-0159)
(AD-728050; A-4I5-2379-11) Avail: NTIS CSCL 11/2

The report describes the effect of diffusional prestressing on the mechanical properties of magnesium oxide single crystals. Flexural specimens were compressively prestressed by diffusionally developing an NiO-MgO solid solution zone at the surfaces. The compressive prestress occurred due to the favorable difference in coefficient of expansion between the host crystal and the solid solution. Using experimentally determined and known material characteristics, the anticipated quantitative effect of prestressing was calculated. Flexural specimens were mechanically and microscopically characterized. For comparative purposes, specimens were prepared by thermally annealing and by diffusionally annealing crystals that originally either contained grown-in dislocations or fresh dislocations. Half of the specimens were tested after the reintroduction of fresh dislocations.
Author (GRA)

N72-12522# Army Foreign Science and Technology Center, Charlottesville, Va.
THE FILM FORMING PROPERTIES OF COMPOSITION COMPOUNDS BASED ON STYROLMALEIC COPOLYMERS
G. F. Filippichev and O. E. Kuzmicheva 21 Jul. 1971 15 p refs Transl. into ENGLISH from Lakokrasochnye Materialy i ikh Primenenie (Leningrad), no. 6, 1969
(AD-728531; FSTC-HT-23-515-71; T7023012301) Avail: NTIS CSCL 11/3

Styrolmaleic films with improved properties were synthesized. Various hardening agents used during polymerization are described.
Author (GRA)

N72-12523# Naval Air Engineering Center, Philadelphia, Pa. Aero Materials Dept.
EVALUATION OF DRY-TO-THE-TOUCH ULTRA THIN FILM, WATER DISPLACING, CORROSION PREVENTIVE COMPOUNDS
W. E. Knight 31 Jul. 1971 14 p refs
(F Proj. 00-543-202)
(AD-728779; NADC-MA-7145) Avail: NTIS CSCL 11/3

The report covers the evaluation of a material which is ultra thin, has good water displacing properties, and possesses corrosion preventive properties, and which is dry-to-the-touch when used on land-based aircraft in dusty areas.
Author (GRA)

N72-12524# Yeshiva Univ., New York. Belfer Graduate School of Science.
MECHANICAL AND VISCO-ELASTIC PROPERTIES OF ALLOY GLASSES
Martin Goldstein and H. S. Chen Jul. 1971 22 p refs
(Contract N00014-69-A-0411)
(AD-728048) Avail: NTIS CSCL 11/6

Metallic alloy glasses were prepared, and the study of their anelastic and visco-elastic properties, and flow fracture observations, are reported. The alloys were: Pd sub x Au sub y Si sub z, Pd sub x Ag sub y Si sub z, Pd sub x Cu sub y Si sub z, and Ni sub x Pd sub y P sub z.
Author (GRA)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also 08 Computers.

N72-12525 Mitsubishi Heavy-Industries, Ltd., Tokyo (Japan).
SELF-ADJOINT DIFFERENTIAL EQUATIONS AND VARIATIONAL PRINCIPLE, PART 1
Tsutomu Fujino Aug. 1971 11 p In JAPANESE; ENGLISH summary
(MTB-74-Pt-1) Copyright. Avail: Issuing Activity

A theoretical study of the calculus of variations with respect to self-adjoint differential equations is considered. It is necessary to find a functional which generates the differential equation governing phenomena of continuum mechanics. This can be done when the phenomenon is described by a self-adjoint differential equation. The procedure for finding the functionals corresponding to systems of multivariable equations of the second order is presented.
Author

N72-12526*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DEVELOPMENT AND APPLICATION OF A GRADIENT METHOD FOR SOLVING DIFFERENTIAL GAMES
David A. Roberts and Raymond C. Montgomery Washington Nov. 1971 46 p refs Part of the inform. presented in this paper was included in David A. Roberts' M.S. thesis entitled "The Application of Gradient Methods to Differential Games" submitted to George Washington Univ., May 1971
(NASA-TN-D-6502; L-7770) Avail: NTIS CSCL 12A

A technique for solving n-dimensional games is developed and applied to two pursuit-evasion games. The first is a two-dimensional game similar to the homicidal chauffeur but modified to resemble an airplane-helicopter engagement. The second is a five-dimensional game of two airplanes at constant altitude and with thrust and turning controls. The performance function to be optimized by the pursuer and evader was the distance between the evader and a given target point in front of the pursuer. The analytic solution to the first game reveals that both unique and nonunique solutions exist. A comparison between the gradient results and the analytic solution shows a dependence on the nominal controls in regions where nonunique solutions exist. In the unique solution region, the results from the two methods agree closely. The results for the five-dimensional two-airplane game are also shown to be dependent on the nominal controls selected and indicate that initial conditions are in a region of nonunique solutions.
Author

N72-12527*# Brown Univ., Providence, R.I. Center for Dynamical Systems.
CONTROL OF FUNCTIONAL DIFFERENTIAL EQUATIONS TO TARGET SETS IN FUNCTION SPACE
H. T. Banks and G. A. Kent Jul. 1971 59 p refs Sponsored in part by US Navy
(Grants NGL-40-002-015; AF-AFOSR-0693-67B; DA-31-124-ARO(D)-270)
(NASA-CR-124613; CDS-TR-71-2) Avail: NTIS CSCL 12A

Optimal control of systems governed by functional differential equations of retarded and neutral type is considered. Problems with function space initial and terminal manifolds are investigated. Existence of optimal controls, regularity, and bang-bang properties are discussed. Necessary and sufficient conditions are derived, and several solved examples which illustrate the theory are presented. Author

N72-12528*# Brown Univ., Providence, R.I. Div. of Applied Mathematics.
DISSIPATIVE SYSTEMS
J. P. LaSalle Jun. 1971 14 p refs Presented at NRL Conf. on Ordinary Differential Equations, Washington, D. C., Jun. 1971
(Grant NGL-40-002-015; NSF GP-15132; AF-AFOSR-0693-67B; Contracts DA-31-124-ARO(D)-270; N00014-67-A-0191-0009)
(NASA-CR-124624) Avail: NTIS CSCL 12A

The abstract theory presented shows how the theory of dissipative systems of ordinary differential equations can be extended to include a wide class of functional and partial differential equations. Since the basic hypotheses are all in terms of boundedness, finding sufficient conditions in terms of Liapunov functions was not difficult. Work is being undertaken to solve some nontrivial examples to illustrate how the theory can applied. Author

N72-12529*# Scripta Technica, Inc., Washington, D.C.
OPTIMIZATION OF LINEAR, TIME INVARIANT SYSTEMS BY MEANS OF QUADRATIC CRITERIA M.S. Thesis - Technion - Israel Inst. of Tech., Feb. 1970
Hillel Lurie NASA Dec. 1971 58 p refs Transl. into ENGLISH of Israeli M.S. thesis p 1-42
(Contract NASw-2036)
(NASA-TT-F-13777) Avail: NTIS CSCL 12A

The optimization of linear, time-variant systems by means of quadratic criteria is discussed. The objective is to find an optimal controller that will minimize the cost function as contained in a mathematical formula. The necessary and sufficient conditions for the existence of an optimal solution and to find the properties of such a solution if it does exist is the purpose of the investigation. The method of solution is based on the calculus of variations and analysis of the results obtained by methods of linear algebra. Author

N72-12530*# Dartmouth Coll., Hanover, N.H.
AERIAL MEASUREMENT ERROR WITH A DOT PLANIMETER: SOME EXPERIMENTAL ESTIMATES
Robert S. Yuill Aug. 1971 9 p refs
(NASA Order W-13318; Contract DI-14-08-0001-19958)
(NASA-CR-124609; NASA-Task-160-75-71-03; IR-USGS-213) Avail: NTIS CSCL 12A

A shape analysis is presented which utilizes a computer to simulate a multiplicity of dot grids mathematically. Results indicate that the number of dots placed over an area to be measured provides the entire correlation with accuracy of measurement, the indices of shape being of little significance. Equations and graphs are provided from which the average expected error, and the maximum range of error, for various numbers of dot points can be read. Author

N72-12531*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF A DISCRETE STEEPEST ASCENT METHOD WITH THE CONTINUOUS STEEPEST ASCENT METHOD FOR OPTIMAL PROGRAMING
A. Gary Childs Washington Dec. 1971 41 p refs
(NASA-TN-D-6549; L-7949) Avail: NTIS CSCL 12A

A discrete steepest ascent method which allows controls which are not piecewise constant (for example, it allows all continuous piecewise linear controls) was derived for the solution to optimal programming problems. This method is based on the continuous steepest ascent method of Bryson and Denham and new concepts introduced by Kelley and Denham in their development of compatible adjoints for taking into account the effects of numerical integration. The method is a generalization of the algorithm suggested by Canon, Cullum, and Polak with the details of the gradient computation given. The discrete method was compared with the continuous method for an aerodynamics problem for which an analytic solution is given by Pontryagin's maximum principle, and numerical results are presented. The discrete method converges more rapidly than the continuous method at first, but then for some undetermined reason, loses its exponential convergence rate. A comparsion was also made for the algorithm of Canon, Cullum, and Polak using piecewise constant controls. This algorithm is very competitive with the continuous algorithm. Author

N72-12532# Academy of Sciences (USSR), Moscow.
ALGEBRA OF DIFFERENCE OPERATORS
L. S. Frank 1971 40 p refs In RUSSIAN
(RP-69) Avail: NTIS

A single-parameter family of difference operators which forms an algebra with involution is considered. A difference analogue of the Gording inequality for operators with a nonnegative Hermitian is shown. Transl. by K.P.D.

N72-12533# Academy of Sciences (USSR), Moscow.
A COMPUTER APPLICATION TO THE PROBLEM OF REDUCING INTENSITY DISTRIBUTION
V. S. Artyukh, V. I. Kostenko, and V. M Malofeyev 1970 14 p refs In RUSSIAN
(PR-42) Avail: NTIS

The problem of making detailed maps of radiative regions based on smoothing a diagram of antenna direction has occurred in the study of extended radio sources. The problem is described mathematically. Applications to Jupiter and the Crab nebula are considered. Transl. by K.P.D.

N72-12534# Systems Technology, Inc., Princeton, N.J.
MINIMUM ORDER STATE RECONSTRUCTION FILTERS FOR CONSTANT PLANTS
Lee Gregor Hofmann May 1971 31 p refs Backup document for AIAA Synoptic scheduled for publication in AIAA Journal, Apr. 1972
(Contract F33615-69-C-1359)
Avail: NTIS

Optimal control laws and decoupling control laws usually require the complete plant state. Procedures are developed for obtaining the equations for a minimum order filter which can reconstruct the complete plant state from the given measurements when the rank of the augmented control effectiveness matrix is equal to the number of measurements, and a certain matrix constructed from the plant matrices, is nonsingular. If m is the number of measurements for an nth order plant, this filter requires a total of (n-m) integrations and differentiations. For the practical case for which no differentiations are required, the filter requires (n-m) integrations for realization. A certain partition of the augmented control application matrix must have a nonvanishing determinant for this case. An application to a significant multiple control-point problem in aircraft flight control illustrates use of the theory. Author

N72-12535# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Festkoerperforschung.
PHONONS AND LIBRONS IN SOLID HYDROGEN AND DEUTERIUM Ph.D. Thesis - Technische Hochschule,

Aachen, West Germany
Franz-Georg Mertens Feb. 1971 109 p refs
(JUL-734-FF) Avail: AEC Depository Libraries

A theory is developed within the frame of random phase approximation which describes all low-lying collective excitations (phonons, librons, and mixed excitations, which arise because of the coupling) in pure ortho-H2 and para-D2. The short range correlations between the molecules are taken into account by introducing a two particle function into the wave function of ground and excited states. The energy of the ordered ground state is written as a cluster expansion and the variational parameters are determined by minimizing the first two terms of the expansion. The convergence of the expansion is discussed in detail. The disordered hcp phase is also considered. Author

N72-12536# National Physical Lab., Teddington (England). Div. of Numerical Analysis and Computing.
THE NUMERICAL EVALUATION OF B-SPLINES
M. G. Cox Aug. 1971 34 p refs
(NPL-DNAC-4) Avail: NTIS

The conventional method of evaluating B-splines by means of divided differences is numerically unstable. A relation between B-splines of consecutive degrees is derived which enables B-splines to be evaluated in a stable and efficient fashion. Analyses of error growth in the conventional and the stable methods are carried out. For the stable method an a priori relative error bound is obtained. Author (ESRO)

N72-12537# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
ON SOME CONTRIBUTIONS TO MULTIPLE DECISION THEORY
Shanti S. Cupta and Klaus Nagel Jun. 1971 28 p refs
(Contract N00014-67-A-0226-0014; F33615-67-C-1244)
(AD-725521; Mimeograph-Ser-25) Avail: NTIS CSCL 12/1

In the paper the authors discuss the multiple decision (selection and ranking) rules in a general decision theoretic framework. More specifically, the paper describes the subset selection problem. The earlier part of the paper describes the general framework and gives some known results for sake of completeness; in the latter part of the paper the authors give some new results dealing with the subset selection problem for a class of discrete distributions (Section 2). Some relevant tables for these procedures are included. The derivation of rules with some desirable property is made in Section 3 using the likelihood ratio criterion. Author (GRA)

N72-12538# Colorado Univ., Boulder. Dept. of Mathematics.
TRUNCATION ERROR ANALYSIS OF EXPANSIONS OF FUNCTIONS OF AEROSPACE PHYSICS AND ENGINEERING. Progress Report
Wolfgang J. Thron and William B. Jones 27 Jul. 1971 8 p refs
(Grant AF-AFOSR-1888-70; AF Proj. 9749)
(AD-728236; AFOSR-TR-71-2176) Avail: NTIS CSCL 12/1

The report describes extensions of truncation error analysis for various classes of continued fractions. Author (GRA)

N72-12261*# Geological Survey, Denver, Colo.
A THERMAL MODEL FOR ANALYSIS OF INFRARED IMAGES
Kenneth Watson *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 16 p refs (See N72-12248 03-13)
Avail: NTIS CSCL 12A

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also 13 Geophysics, and 30 Space Sciences.

N72-12539 World Meteorological Organization, Geneva (Switzerland).
SATELLITE AND COMPUTER APPLICATIONS TO SYNOPTIC METEOROLOGY
1971 100 p refs Presented at the 5th Session of the Comm. for Synoptic Meteorol., Geneva, 15 Jun. - 3 Jul. 1970
(WMO-283) Copyright. Avail: Issuing Activity

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4. OPERATIONAL USE OF SIRS DATA W. L. Smith and E. B. Fawcett p 37-62 (See N72-12541 03-20)
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N72-12540 World Meteorological Organization, Geneva (Switzerland).
THE USE OF SATELLITE INFORMATION FOR WEATHER ANALYSIS AND FORECAST
A. I. Burtsev and A. D. Cistjakov *In its* Satellite and Computer Appl. to Synoptic Meteorol. 1971 p 19-36 (See N72-12539 03-20)
Copyright. Avail: Issuing Activity

Methods of synoptic analysis using satellite data for prognostic activities in the USSR are presented. Topics discussed include: (1) operational application of satellite data for synoptic analysis, (2) routine application of satellite information for synoptic estimation and specification of some meteorological parameters, (3) computerized analysis of satellite information, (4) use of satellite information in numerical analysis, (5) use of satellite data in numerical prediction, (6) use of cloud satellite data for the verification of synoptic forecasts of the motion and evolution of large-scale atmospheric distrubances, and (7) use of satellite cloud data in the forcasting of meteorological elements and weather phenomena. F.O.S.

N72-12541 World Meteorological Organization, Geneva (Switzerland).
OPERATIONAL USE OF SIRS DATA
William L. Smith and Edwin B. Fawcett *In its* Satellite and Computer Appl. to Synoptic Meteorol. 1971 p 37-62 (See N72-12539 03-20)
Copyright. Avail: Issuing Activity

The satellite observations from the satellite infrared spectrometer (SIRS) experiment onboard the Nimbus 3 spacecraft are discussed. The use and applications of SIRS observations in daily NMC operations, and a test on the use of SIRS data for ocean analysis and prognosis are described. F.O.S.

N72-12542 World Meteorological Organization, Geneva (Switzerland).
AN OPERATIONAL SYSTEM FOR NUMERICAL WEATHER PREDICTION
L. Bengtsson and L. Moen *In its* Satellite and Computer Appl. to Synoptic Meteorol. 1971 p 63-88 refs (See N72-12539 03-20)
Copyright. Avail: Issuing Activity

An integrated quasi-geostrophic three-parameter model in operational use at the Swedish Meteorological and Hydrological

Insitute is described. Several forecasts are computed daily over different geographic areas, with different grid lengths, lateral boundary conditions and nonadiabatic heating effects. The importance of a finer horizontal resolution in the forecasts, especially for the vertical motion pattern and the release of latent heat, is demonstrated by several experiments. The so-called grid-telescoping technique has facilitated the operational organization of the computer. The elimination of large boundary errors by this method is illustrated and the possibility of using the medium-speed lines in the Global Telecommunication System for exchanges of boundary values between meteorological centers is pointed out. Author

N72-12543 World Meteorological Organization, Geneva (Switzerland). Joint Organizing Committee for GARP.
THE GARP PROGRAMME ON NUMERICAL EXPERIMENTATION
R. V. Garcia Apr. 1971 41 p refs *Its* GARP Publ. No. 7 Prepared jointly with Intern. Council of Sci. Unions
Copyright. Avail: Issuing Activity

The role of the GARP program in numerical experimentation is outlined and following simulation experiments discussed: four-dimensional data assimilation, observing system simulation, spectrum of predictability, compilational considerations, real time operation, and dynamics of tropical motion systems. Numerical experiments related to physical processes in the atmosphere are also considered. ESRO

N72-12544+ Freie Univ., Berlin (West Germany).
METEOROLOGICAL DATA. VOLUME 100, NO. 3: THE DEVIATIONS OF MEDIAN MONTHLY GROUND PRESSURE FLUCTUATIONS ON THE NORTHERN HEMISPHERE [METEOROLOGISCHE ABHANDUNGEN. BAND 100, HEFT 3: DIE STREUUNGEN DER MITTLEREN MONATLICHEN BODENDRUCKAENDERUNGEN AUF DER NORDHEMISPHAERE]
Diethard Westerholt 1971 48 p refs In GERMAN; ENGLISH summary
Avail: NTIS

An analysis of meterological parameter dispersion for the period 1931 to 1960 is given. The zones on the Northern Hemisphere, where the variation of middle monthly pressure changes remain under 100%, are characterized. Monthly changes in pressure distribution and the scattering of monthly mediums are also examined. Meterological charts are included. Author

N72-12545# Deutscher Wetterdienst, Offenbach am Main (West Germany).
REPORT OF THE GERMAN WEATHER SERVICE, VOLUME 16 NO. 122: WINTER SLIPPERINESS ON LONG DISTANCE HIGHWAYS IN THE FEDERAL REPUBLIC OF GERMANY [BERICHTE DES DEUTSCHEN WETTERDIENSTES, NR. 122, BAND 16: WINTERLICHE GLAETTE AUF DEN FERNVERKEHRSSTRASSEN DER BUNDESREPUBLIK DEUTSCHLAND]
Albrecht Sandreczki 1971 30 p refs In GERMAN
(DK-551.578.46:551.574.42:656.1) Avail: NTIS

The actual road conditions are of importance for traffic. Slipperiness on roads in winter due to ice and snow impairs traffic safety. The study shows the reasons for slipperiness on roads, and the frequency rate of slipperiness on German Federal highways. Two maps give information on the distribution of the slipperiness in winter for the period 1956/57 to 1960/61. Author

N72-12546*# Control Data Corp., Minneapolis, Minn.
DETERMINATION OF STRATOSPHERIC TEMPERATURE AND HEIGHT GRADIENTS FROM NIMBUS 3 RADIATION DATA
G. W. Nicholas, D. N. Hovland, and A. D. Belmont Washington NASA Nov. 1971 66 p refs
(Contract NAS8-25949)
(NASA-CR-1942) Avail: NTIS CSCL 04B

To improve the specification of stratospheric horizontal temperature and geopotential height fields from satellite radiation data, needed for high flying aircraft, a technique was derived to estimate data between satellite tracks using interpolated IRIS 15-micron data from Nimbus III. The interpolation is based on the observed gradients of the MRIR 15-micron radiances between subsatellite tracks. The technique was verified with radiosonde data taken within 6 hours of the satellite data. The sample varied from 1126 pairs at low levels to 383 pairs at 10 mb using northern hemisphere data for June 15 to July 20, 1969. The data were separated into five latitude bands. The Rms temperature differences were generally from 2 to 5 C for all levels above 300 mb. From 500 to 300 mb RMS differences vary from 4 to 9C except at high latitudes which show values near 3C. The RMS differences between radiosonde heights and those calculated hydrostatically from the surface were from 30 to 280 meters increasing from the surface to 10 mb. Integration starting at 100 mb reduced the RMS difference in the stratosphere to 20 to 120 meters from 70 to 10 mb. From a comparison with actual operational maps at 50 and 10 mb, it appears the techniques developed produce analyses in general agreement with those from radiosonde data. In addition, they are able to indicate details over areas of sparse data not shown by conventional techniques. Author

N72-12547*# National Aeronautics and Space Administration, Washington, D.C.
METEOROLOGICAL ASPECTS OF ATMOSPHERIC POLLUTION AND POSSIBILITIES OF OBSERVATION FROM SPACE
K. Ya. Kondratyev and Kh. Yu. Niylisk Nov. 1971 32 p refs Transl. into ENGLISH from Russian report Presented at the 22d Intern. Astronautical Federation Congr., Brussels, Sep. 1971
(NASA-TT-F-14080) Avail: NTIS CSCL 04B

The results of studies are discussed of air pollution on the planetary scale, in terms of its meteorological aspects, and the prospects of remote detection of atmospheric and oceanic pollution from space. The main gaseous pollutants of the atmosphere are considered to be sulfur, nitrogen, and carbon compounds. CO2 is of special importance as changes in CO2 concentration lead to changes in atmospheric thermal radiation. The effects of water vapor on the radiation budget are also considered. Other topics discussed include: aerosol components, remote (satellite) methods for determining atmospheric pollution components, and thermal anomalies of industrial origin. F.O.S.

N72-12548# Joint Publications Research Service, Washington, D.C.
MODIFICATION OF WEATHER AND CLIMATE
Ye. K. Fedorov 4 Nov. 1971 21 p ref Transl. into ENGLISH from Priroda (Moscow), no. 9, 1971 p 36-44
(JPRS-54401; UDC-551.509.6) Avail: NTIS

Methods of modifying the climate and weather through control of meteorological processes, cloud physics, and precipitation are discussed. Examples are presented of attempts to: (1) stimulate or suppress ascending currents; (2) modify elementary physicochemical processes; (3) scatter low supercooled clouds and fogs; (4) prevent hail formation; (5) stimulate precipitation; and (6) accumulate additional snow cover. A.L.

N72-12549# International Geophysical Year World Data Center A, Asheville, N.C.
INSTRUCTIONS FOR COMPLETING HIGH ALTITUDE METEOROLOGICAL DATA FORMS AND DETAILS OF THE PUBLICATION FORMAT
Jul. 1971 46 p refs Revised
Avail: NTIS

Along with the instructions for completing the forms, a description is given to the format in which World Data Center-A will publish the data. A.L.

N72-12550*# Techtran Corp., Glen Burnie, Md.
THE PHYSICS OF EXHAUST CONDENSATES IN THE WAKE OF AIRPLANES
H. J. aufmKampe Washington NASA Dec. 1971 11 p Transl. into ENGLISH from Luftwissen, v. 10, no. 6, 1943 p 171-173
(Contract NASw-2037)
(NASA-TT-F-14047) Avail: NTIS CSCL 01A

The cause of vapor trails which form behind piston engine aircraft is discussed and vapor trail experiments carried out with a Henschel 126 aircraft at altitudes of approximately 10,000 meters are described. Author

N72-12551# National Severe Storms Lab., Norman, Okla.
RAWINSONDE OBSERVATION AND PROCESSING TECHNIQUES AT THE NATIONAL SEVERE STORMS LABORATORY
Stanley L. Barnes, James H. Henderson, and Robert J. Ketchum Apr. 1971 254 p refs
(NOAA-TM-ERL-NSSL-53) Avail: NTIS

GMD-1 rawinsonde systems to obtain soundings with standard radiosonde instruments (both military and civilian versions) are discussed. Specialized data acquisition and processing procedures have been developed, resulting in a high level of confidence in the quality of these data. Quality control is presently a melding of manual and computer techniques, although many of the manual steps could be easily automated given an adequate computer system. A user's guide to the archived soundings which have been reduced to basic meteorological parameters recorded on magnetic tapes. Following brief descriptions of the arrangement and purposes of the various networks and the types of other data available from NSSL, the current observation and reduction procedures are described in detail. Computer programs for quality control and final data reduction are listed and explained. Archive formats are defined and examples given. Appendices include capsule descriptions of each day's operations and weather, and a list of quality evaluations for each archived sounding. Author

N72-12552# Pennsylvania State Univ., University Park. Dept. of Meteorology.
THE EFFECTS OF A CHANGE OF TERRAIN ON WIND PROFILES Final Report, 1 Jul. 1965 - 15 Aug. 1968
A. K. Blackadar and H. A. Panofsky 15 Dec. 1970 83 p refs
(Contract AT(30-1)-3562)
(NYO-3562-3) Avail: NTIS

The alterations produced in an equilibrium wind profile of the surface layer of the atmosphere by a discontinuous change of surface roughness, under various conditions of stability, are investigated. Three distinct but related problems are studied: (1) extension of existing theories in neutral conditions to slightly stable and unstable circumstances; (2) the variation of the stress with height in the vicinity of a change of roughness; and (3) the effect of the roughness change on the turbulent kinetic energy. A special field observation program was conducted to provide data on wind profiles and turbulence statistics under controlled roughness-change conditions. Peterson's theory is discussed and shown to be superior to several older theories as regards its ability to describe the variation of stress and wind shear with height without internal inconsistencies or unjustified assumptions. The nondimensional shear parameter is found to be approximately unity only up to a height of about 1% of the distance downwind from the roughness discontinuity. Only within this height range is the equilibrium relation between stress and wind shear satisfied reasonably well. Author

N72-12553# Royal Aircraft Establishment, Bedford (England). Aero Flight Div.
ON LARGE AND RAPID WIND FLUCTUATIONS WHICH OCCUR WHEN THE WIND HAD PREVIOUSLY BEEN RELATIVELY LIGHT
J. Burnham and M. J. Colmer London Aeron. Res. Council 1971 24 p refs Supersedes RAE-TR-69261; ARC-32205
(ARC-CP-1158; RAE-TR-69261; ARC-32205) Avail: NTIS; HMSO: 35p; PHI: $1.55

Examination of anemometer records obtained at Bedford Airfield for the years 1962-1966 shows that, on about 40 occasions per year, large and rapid changes in windspeed and direction occur in relatively light wind conditions. Such events are associated with convection and do not follow the usual relationship between the size of fluctuations and the mean windspeed. Author (ESRO)

N72-12554# Royal Aircraft Establishment, Bedford (England). Aero Flight Div.
RESULTS OF A SERIES OF FLIGHTS IN THE STRATOSPHERE OVER MOUNTAINOUS TERRAIN IN THE WESTERN USA DURING FEBRUARY 1967
A. McPherson and J. M. Nicholls (Meteorol. Office, Bracknell, Engl.) London Aeron. Res. Council 1971 110 p refs Supersedes RAE-TR-70034; ARC-32579
(ARC-CP-1159; RAE-TR-70034; ARC-32579) Avail: NTIS; HMSO: 1.40; PHI: $5.80

Flights were planned on the basis of tropospheric lee wave forecasts and were usually made along wind at heights from the tropopause to about 50,000 ft over California and Nevada. Mountain waves, deduced from an analysis of the temperature along the flight track, were moderate or strong on four flights. Moderate or severe turbulence and marked temperature changes were encountered on three flights. The results give an insight into the severity of the stratospheric environment and the meteorological conditions in which the severe disturbances occur. Author (ESRO)

N72-12555# Institut Royal Meteorologique de Belgique, Brussels. Regie des Voies Aeriennes et Force Aerienne.
SYNOPTIC OBSERVATIONS Monthly Bulletin, Feb. 1970 [OBSERVATIONS SYNOPTIQUES BULLETIN MENSUEL, FEVRIER 1970]
1971 32 p In FRENCH and DUTCH
Avail: NTIS

Synoptic measurements made at different Belgian weather stations in February 1970 are presented. ESRO

N72-12556# Institut Royal Meteorologique de Belgique, Brussels. Regie des Voies Aeriennes et Force Aerienne.
SYNOPTIC OBSERVATIONS Monthly Bulletin, Jan. 1970 [OBSERVATIONS SYNOPTIQUES BULLETIN MENSUEL, JANVIER 1970]
1971 32 p In FRENCH and DUTCH
Avail: NTIS

Synoptic measurements made at different Belgian weather stations in January 1970 are presented. ESRO

N72-12557# Institut Royal Meteorologique de Belgique, Brussels. Regie des Voies Aeriennes et Force Aerienne.
SYNOPTIC OBSERVATIONS Monthly Bulletin, Dec. 1969 [OBSERVATIONS SYNOPTIQUES BULLETIN MENSUEL, DECEMBRE 1969]
1970 32 p In FRENCH and DUTCH
Avail: NTIS

Synoptic measurements made at different Belgian weather stations in December 1969 are presented. ESRO

N72-12558# Air Force Eastern Test Range, Patrick AFB, Fla.
AN/FPS RADAR STORM TRACKING PROCEDURE FOR CAPE KENNEDY
Irving Kuehnast, Paul Werth, and A. E. Devitt Jun. 1971 16 p
(AD-726098; AFETR-TR-71-2) Avail: NTIS CSCL 04/2

The objective is to develop an effective FPS-44 radar operating procedure for collection of quantitative radar data. Author (GRA)

N72-12559# National Water Commission, Arlington, Va.
PRECIPITATION MODIFICATION Final Report
Jack D. Lacker and Ralph W. Johnson (Washington Univ., Seattle) Jul. 1971 170 p refs
(PB-201534; NWC-EES-71-605) Avail: NTIS CSCL 04B

An evaluation is made of the effectiveness of cloud seeding in increasing precipitation from orographic, convective, and cyclonic storm systems. The evaluation is based on published conclusions of various panels of atmospheric scientists and on the reported results of well designed field tests. Primary interest centers on the leverage increased precipitation may exert in augmenting water supply. Information on the potential impact of increased precipitation on usable water supply, based upon the use of hydrologic models and reservoir storage-yield relationships, is summarized. The nature of potential downwind precipitation effects and environmental side-effects are identified along with the nature of inadvertent modification. A discussion is given of the potential economic feasibility of cloud seeding projects and of the difficulty of assessing the total social benefits and costs of weather modification. The status of the legal and institutional aspects of precipitation modification is given. Author (GRA)

N72-12560# Weather Wing (6th), Andrews AFB, Md.
TERMINAL FORECAST REFERENCE FILE FOR WEATHER WING /6TH/, BASE WEATHER SERVICES DIVISION, ANDREWS AFB, MARYLAND
Frank J. Carvell 1 Jul. 1971 167 p refs
(AD-728208) Avail: NTIS CSCL 04/2

The reference file is prepared to acquaint newly-assigned forecasters with weather conditions peculiar to Andrews AFB and the Washington, D.C. area. It provides a record of approved local forecasting rules and techniques for solving local, forecast problems. It is formatted in 4 Sections -- Section I shows geographic features of the Andrews area, Section II includes the significant synoptic weather features which affect the base, Section III contains climatic summaries of weather parameters and flying conditions of the area, and Section IV contains the approved local forecasting studies and aids. Author (GRA)

N72-12561# Air Force Global Weather Central, Offutt AFB, Nebraska.
VERIFICATION DATA: AFGWC LIMITED AREA MESO-SCALE PREDICTION MODEL
James Kerlin 15 Jul. 1971 27 p
(AD-728201; AFGWC-TN-71-2) Avail: NTIS CSCL 04/2

Forecasts produced by the AFGWC Meso-Scale Prediction Model are compared with observational rawinsonde data from stations within the N. American verification window. Statistical summaries are included for March, April and May 1971. Summaries include frequency distribution and error statistics for 12 and 24 hour forecasts of temperature, D-value and wind at the 850, 700 and 500 mb levels. Author (GRA)

N72-12562# Air Force Global Weather Central, Offutt AFB, Nebraska.
VERIFICATION DATA: AFGWC MACRO-SCALE BAROCLINIC PREDICTION MODEL
James Kerlin 1 Jul. 1971 34 p
(AD-728200; AFGWC-TN-71-1) Avail: NTIS CSCL 04/2

Forecasts produced by the AFGWC Macro-Scale Baroclinic Prediction Model are compared with observational data from rawinsonde sites. Monthly summaries are included for March, April and May 1971. These summaries include frequency distribution and error statistics for 12,24,36 and 48 hour forecasts at 850, 500, 300 and 100 mb. Meteorological parameters verified are temperature, D-value and winds.
Author (GRA)

N72-12563# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
YUMA PROVING GROUND, ARIZONA. CENTRAL METEOROLOGICAL OBSERVATORY Meteorological Data Report
Dec. 1970 76 p
(AD-728138) Avail: NTIS CSCL 04/2

The report contains the following meteorological data collected at Yuma Proving Ground, Arizona during December 1970: Atmospheric precipitation; Atmospheric temperature, Wind; Atmospheric pressure. GRA

N72-12564# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
PANAMA CANAL ZONE. CERRO TIGRE, FORT GULICK, GAMBOA MET VAN NO. 1 Meteorological Data Report
Nov. 1970 63 p
(AD-728135) Avail: NTIS CSCL 04/2

The report contains the following meteorological data collected at Cerro Tigre and Fort Gulick within the Panama Canal Zone during November 1970. GRA

N72-12565# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
PANAMA CANAL ZONE. STABILIZATION PONDS, EMPIRE RANGE MET VAN NO. 2
Nov. 1970 44 p refs
(AD-728137) Avail: NTIS CSCL 04/2

The report contains the following meteorological data collected at sites within the Panama Canal Zone during November 1970: Atmospheric precipitation, Atmospheric temperature, Humidity, Atmospheric pressure, and Wind. GRA

N72-12566# Army Coastal Engineering Research Center, Washington, D.C.
STORM SURGE ON THE OPEN COAST: FUNDAMENTALS AND SIMPLIFIED PREDICTION
B. R. Bodine May 1971 66 p refs
(AD-728128; TM-35) Avail: NTIS CSCL 04/2

A quasi-two-dimensional numerical model for open-coast storm-surge computations is discussed from the standpoint of underlying assumptions, range of validity, calibration, and application. While it is possible to make computations manually, electronic digital calculations are generally preferred. Elementary aspects of hurricanes and the physical factors of storm-generation processes are discussed. The basic hydrodynamic equations are given, together with the assumptions generally made in their development. The equations consistent with the model are reduced forms of the basic equations in which several terms have been neglected. These omissions are indicated, and their effects on the resulting numerical scheme are discussed. The use of design hurricanes for engineering studies is treated. Effects of astronomical tide, initial water level, and atmospheric-pressure setup are considered. A problem is solved for the Chesapeake Bay Entrance by computer and manually. The computer program used is listed. Author (GRA)

N72-12567# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
EDGEWOOD ARSENAL, MARYLAND Meteorological Data Report
Nov. 1970 40 p
(AD-728109) Avail: NTIS CSCL 04/2

The report contains the following meteorological data collected at Edgewood Arsenal, Maryland during November 1970: Atmospheric precipitation; Atmospheric temperature; Wind; Atmospheric pressure. GRA

N72-12568# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
FORT HUACHUCA, ARIZONA: CENTRAL METEOROLOGICAL OBSERVATORY Meteorological Data Report
Dec. 1970 41 p
(AD-728111) Avail: NTIS CSCL 04/2

The report contains the following meteorological data

collected at sites within Fort Huachuca, Arizona during December 1970: Atmospheric precipitation; Atmospheric temperature; Humidity; Atmospheric pressure; Wind. GRA

N72-12569# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
PANAMA CANAL ZONE: TANK FARM, NRL 1, NRL 2, HAWK 1, HAWK 2 Meteorological Data Report
Nov. 1970 60 p
(AD-728113) Avail: NTIS CSCL 04/2

The report contains the following meteorological data collected at Tank Farm, NRL 1 and 2, Hawk 1 and 2 on the Panama Canal Zone during November 1970: Atmospheric precipitation; Atmospheric temperature; Humidity, Atmospheric pressure; Wind. GRA

N72-12570# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
PANAMA CANAL ZONE. GUN HILL Meteorological Data Report
Dec. 1970 75 p refs
(AD-728136) Avail: NTIS CSCL 04/2

The report contains the following meteorological data collected by Army meteorological teams during December 1970 at Gun Hill, Panama: Atmospheric precipitation; Atmospheric temperature; Wind; Atmospheric pressure. GRA

N72-12571# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
PANAMA CANAL ZONE. CHIVA-CHIVA OPEN, CHIVA-CHIVA JUNGLE Meteorological Data Report
Nov. 1970 60 p refs
(AD-728134) Avail: NTIS CSCL 04/2

The report contains the following meteorological data collected by Army meteorological teams in November 1970 at Chiva-Chiva, Panama Canal Zone: Atmospheric precipitation; Atmospheric temperature; Wind; Atmospheric pressure. GRA

N72-12572# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
MAYNARD, MASSACHUSETTS. CENTRAL METEOROLOGICAL OBSERVATORY Meteorological Data Report
Dec. 1970 76 p
(AD-728133) Avail: NTIS CSCL 04/2

The report contains the following meteorological data collected by meteorological teams at Maynard, Massachusetts during December 1970: Atmospheric precipitation; Atmospheric temperature; Wind; Atmospheric pressure. GRA

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N72-12573# Technische Hogeschool, Eindhoven (Netherlands).
SENSING INERTIAL ROTATION WITH TUNING FORKS
P. J. Jeuken, C. Huber, and C. E. Mulders Sep. 1971 25 p refs
(TH-71-E-22; ISBN-90-6144-022-X) Avail: NTIS

One of several principles applicable to the problem of detecting rotation in inertial space is that of the vibrating tuning fork. All conceivable forms of output signals obtainable from the tuning fork as a rotation sensor are exhibited systematically. Besides the commonly used Coriolis effect, the frequency shift produced by rotation is noteworthy as a possible useful phenomenon. Author

N72-12574# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
AUTOMATIC CONTROL OF A DEEP SPACE DRAG-FREE PROBE
Marcel Bismut 1971 6 p refs Presented at 4th Congr. of the Intern. Fedration on Automatic Control (IFAC), Dubrovik, Yugoslavia, 6-10 Sep. 1971
(ONERA-TP-952) Avail: NTIS

In a project of a drag-free heliocentric probe, the residual perturbating acceleration must be less than 10 to the minus 12th m/sq sec. The probe is constrained to follow the unperturbated orbit of an internal proof mass, protected from the external forces and free from any material link. In spite of all precautions, the proof mass is, however, still subjected to spurious accelerations higher than 10 to the minus 10th m/sq sec, the origin of which is within the probe itself. To reduce the residual acceleration it is spun at 2 rpm about an axis perpendicular to the orbit plane. The control algorithm includes a linear estimator which estimates all the state variables used in the control, in particular the absolute velocity and acceleration of the proof mass. In normal operation, without meteorite impact, the limit cycle, simulated on an analog computer, has an amplitude of 0.0001 meter and a period longer than 100 seconds. The gas consumption stays small at 2 kg/year. Author

N72-12575*# Ohio State Univ. Research Foundation, Columbus.
TECHNIQUES FOR GENERATION OF CONTROL AND GUIDANCE SIGNALS DERIVED FROM OPTICAL FIELDS, PART 2 Final Report
H. Hemami, R. B. McGhee, and S. R. Gardner Washington NASA Nov. 1971 141 p refs
(Grant NGR-36-008-076)
(NASA-CR-1798; RF-2421) Avail: NTIS CSCL 17G

The development is reported of a high resolution technique for the detection and identification of landmarks from spacecraft optical fields. By making use of nonlinear regression analysis, a method is presented whereby a sequence of synthetic images produced by a digital computer can be automatically adjusted to provide a least squares approximation to a real image. The convergence of the method is demonstrated by means of a computer simulation for both elliptical and rectangular patterns. Statistical simulation studies with elliptical and rectangular patterns show that the computational techniques developed are able to at least match human pattern recognition capabilities, even in the presence of large amounts of noise. Unlike most pattern recognition techniques, this ability is unaffected by arbitrary pattern rotation, translation, and scale change. Further development of the basic approach may eventually allow a spacecraft or robot vehicle to be provided with an ability to very accurately determine its spatial relationship to arbitrary known objects within its optical field of view. Author

N72-12576*# Bellcomm, Inc., Washington, D.C.
THE QUASI-INERTIAL AND WIDE-DEADBAND MODES AS BACKUP ATTITUDE OPTIONS FOR THE SKYLAB MISSION
B. D. Elrod 19 Jun. 1971 71 p refs
(Contract NASw-417)
(NASA-CR-123266; TM-71-1022-3; BA-145A) Avail: NTIS CSCL 17G

The quasi-inertial (QI) and wide deadband (WDB) modes were investigated as alternatives to the solar inertial (SI) mode in case two control moment gyros fail during the Skylab mission. Both modes provide a substantial reduction in propellant requirements from the solar interial hold requirement with either the orbital assembly/thruster attitude control system or service module reaction control system. Spacecraft motion in the QI mode is produced by a command rate and results in a small amplitude oscillation (17 deg, maximum) about the SI orientation. In the WDB mode a somewhat similar, but larger amplitude motion (35 deg maximum) about the SI orientation is developed by appropriate choice of controller deadbands and switch line slopes. Author

N72-12577*# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
AIRCRAFT ALTITUDE DETERMINATION USING MULTI-PATH INFORMATION IN AN ANGLE-MEASURING NAVIGATION SATELLITE SYSTEM
David Kurjan 30 Sep. 1971 64 p refs
(Grant NGL-39-010-087)
(NASA-CR-124625; Rept-72-12) Avail: NTIS CSCL 17G

In an angle-measuring navigation satellite system using a pair of crossed interferometers located on a satellite in synchronous orbit, three parameters are needed to determine a user's position unambiguously. These are the phase differences between received signals which were transmitted by the two antennas on each of the two interferometers, and the user's altitude. The two phase difference measurements yield a line of possible user locations, and the addition of the altitude measurement reduces this line to a single point. A method is proposed which makes use of the navigation signals received after reflection off the earth's surface. The iterative procedure employs the arrival time difference between direct and reflected signals. Based on previous calculations of errors in measuring the electrical parameters it is concluded that, for North Atlantic coverage and specular reflection, altitude measurements can be made with a 1-sigma error of 65 meters. Author

N72-12578# National Aviation Facilities Experimental Center, Atlantic City, N.J.
MODELING AND ANALYSIS OF AIR TRAFFIC CONTROL VOICE COMMUNICATION CHANNEL LOADING Interim Report, May 1969 - May 1971
Allen C. Busch Nov. 1971 55 p
(FAA Proj. 012-604-01X)
(FAA-RD-71-78; FAA-NA-71-42) Avail: NTIS

An effort to analyze and model by means of a nonreal-time simulation programming language, in this case GPSS, some of the characteristics of an air traffic control (ATC) air/ground/air voice communications channel is described. The functional entities or parameters of the model and the statistical characteristics of these parameters are presented. Furthermore, a comparison is made between the modeling outputs and real field derived measures of system output or performance. The conclusions are that this type of modeling and analysis can be a powerful and efficient tool for ATC simulation and system analysis provided that the model parameters adequately coincide with real system parameters and that real operational data are used to quantify the dependent variables in the model. Author

N72-12579*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STAR TRACKER FOR THE APOLLO TELESCOPE MOUNT
Charles E. Lee 30 Jun. 1971 39 p refs
(NASA-TM-X-64622) Avail: NTIS CSCL 17G

The star tracker for the Apollo Telescope Mount (ATM) has been designed specifically to meet the requirements of the Skylab vehicle and mission. The functions of the star tracker are presented, as well as descriptions of the optical-mechanical assembly (OMA) and the star tracker electronics (STE). Also included are the electronic and mechanical specifications, interface and operational requirements, support equipment and test requirements, and occultation information. Laboratory functional tests, environmental qualification tests, and life tests have provided a high confidence factor in the performance of the star tracker in the laboratory and on the Skylab mission. Author

N72-12580*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
ON OPTIMAL SCHEDULING AND AIR TRAFFIC CONTROL IN THE NEAR TERMINAL AREA M.S. Thesis
Alexander Hippocrates Sarris Sep. 1971 170 p refs
(Grants NGL-22-009-124; AF-AFOSR-1941-70)
(NASA-CR-124640; ESL-R-459) Avail: NTIS CSCL 01E

A scheme is proposed for automated air traffic control of landing aircraft in the vicinity of the airport. Each aircraft is put under the control of an airport-based computer as soon as it enters the near-terminal area (NTA). Scheduling is done immediately thereafter. The aircraft is given a flight plan which, if followed precisely, will lead it to the runway at a prespecified time. The geometry of the airspace in the NTA is chosen so that delays are executed far from the outer marker, and violations of minimum altitude and lateral separations are avoided. Finally, a solution to the velocity mix problem is proposed. Author

N72-12581*# Computer Sciences Corp., Huntsville, Ala.
TECHNIQUES OF ORBITAL DECAY AND LONG-TERM EPHEMERIS PREDICTION FOR SATELLITES IN EARTH ORBIT
B. F. Barry, R. S. Pimm, and C. K. Rowe Nov. 1971 141 p refs
(Contract NAS8-26113)
(NASA-CR-121053) Avail: NTIS CSCL 22C

In the special perturbation method, Cowell and variation-of-parameters formulations of the motion equations are implemented and numerically integrated. Variations in the orbital elements due to drag are computed using the 1970 Jacchia atmospheric density model, which includes the effects of semiannual variations, diurnal bulge, solar activity, and geomagnetic activity. In the general perturbation method, two-variable asymptotic series and automated manipulation capabilities are used to obtain analytical solutions to the variation-of-parameters equations. Solutions are obtained considering the effect of oblateness only and the combined effects of oblateness and drag. These solutions are then numerically evaluated by means of a FORTRAN program in which an updating scheme is used to maintain accurate epoch values of the elements. The atmospheric density function is approximated by a Fourier series in true anomaly, and the 1970 Jacchia model is used to periodically update the Fourier coefficients. The accuracy of both methods is demonstrated by comparing computed orbital elements to actual elements over time spans of up to 8 days for the special perturbation method and up to 356 days for the general perturbation method. Author

N72-12582# National Bureau of Standards, Washington, D.C. Heat Div.
INTENSITY DISTRIBUTION MEASUREMENTS OF A 300-mm HAZARD OR CODE BEACON WITH A TYPE Q750T12CL LAMP, TESTED FOR SHIP INSTALLATION DIVISION, NAVAL AIR SYSTEMS COMMAND
1 Sep. 1971 12 p
(Rept-221.12-1E/71) Avail: NTIS

Test results of the optical system for the hazard or code beacon are reported. Undesirable features of the design are listed, and the test procedures for determining the intensity distribution characteristics of the 750-Watt, 120-Volt, Q750T12CL lamp are described. F.O.S.

N72-12583# National Bureau of Standards, Washington, D.C. Optical Radiation Section.
DEVELOPMENT, TESTING, AND EVALUATION OF VISUAL LANDING AIDS Consolidated Progress Report, 1 Apr. - 30 Jun. 1971
1 Sep. 1971 19 p refs
(NBS Proj. 2211511; NBS Proj. 2211514; NBS Proj. 2211680; NBS Proj. 2211681)
(NBS-10606) Avail: NTIS

The developments during this period are reported, and include the work in developing visibility meters and their application, airfield lighting and marking, and carrier lighting and marking. A list of publications and specifications reviewed is also included. F.O.S.

N72-12584# National Bureau of Standards, Washington, D.C. Inst. for Basic Standards.
REPORT OF TEST OF PHOTOMETRIC MEASUREMENTS OF A CONDENSER-DISCHARGE TYPE BEACON MANUFACTURED BY DIELECTRIC COMMUNICATIONS DIVI-

SION OF SOLA BASIC INDUSTRIES, TESTED FOR FEDERAL AVIATION ADMINISTRATION
13 Oct. 1971 8 p
(Rept-221.12-2E/71) Avail: NTIS

The results of photometric and electrical measurements of a condenser-discharge type beacon are reported. The power supply, flash head, junction box, and the control and monitor assembly for the strobe guidance beacon, Model 200K70 are described along with the test procedures. F.O.S.

N72-12585# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.
ESTIMATED INSTANTANEOUS AIRBORNE TRAFFIC IN THE NORTH ATLANTIC
Chester E. Dunmire May 1970 15 p refs
(Proj. 197-622-02R)
Avail: NTIS

Available oceanic traffic data are analyzed to estimate the maximum number of aircraft likely to be airborne simultaneously in the North Atlantic airspace for first generation operational satellite systems. The air traffic control area for the initial satellite service is limited to the area between 20 N and 65 N within 10 W and 80 W. Data showing the activity for five oceanic control areas are presented. Estimates of annual increase from 1970 through 1979 are included. F.O.S.

N72-12586# National Bureau of Standards, Washington, D.C. Engineering Mechanics Section.
STATIC TESTS OF L-837 AIRPORT MARKER LIGHT BASES
George F. Sushinsky Jul. 1971 21 p ref
(NBS Proj. 2211680)
(NBS-10453) Avail: NTIS

Static compressive load tests were performed on L-837 airport marker light bases. The bases were proof-loaded to 1000.000 lbf in assembly with currently used airport landing light fixtures of two different designs to determine compatibility of each piece in the assembled units. The bases, without landing light fixtures, were then over-loaded to determine load carrying capabilities and failure characteristics. Failures in the base flange and in the base sidewall were separately generated. Local yielding in the flange area was the more significant factor in strength considerations of these light bases. Author

N72-12587# Federal Aviation Administration, Washington, D.C.
SYSTEM DESIGN FOR AN ALL WEATHER AIRPORT SURFACE TRAFFIC SYSTEM
26 Apr. 1971 135 p refs
(RD-620:63965) Avail: NTIS

The design requirements and development plan for an all weather system for controlling airport surface traffic are presented. The stages in progressing from the current system for controlling airport surface traffic to an all weather system are described and include: existing system, visual signalling, detection, alarm/priority logic, computer processing, and reduced visibility guidance and control. F.O.S.

N72-12588# Federal Aviation Administration, Washington, D.C. Systems Analysis Div.
ESTIMATED INSTANTANEOUS AIRBORNE TRAFFIC IN THE PACIFIC
Chester E. Dunmire May 1970 14 p refs
(Proj. 197-622-02R)
Avail: NTIS

Estimates of the maximum number of aircraft likely to be airborne simultaneously over the Pacific are developed for use in planning operational satellite services. The operational satellite coverage area is assumed to extend from 40 S to 60 N and 120 W to 120 E, excluding Manila and land masses near New Guinea. The annual instantaneous airborne count estimates for busy day periods in the Pacific are given for the period 1969 to 1979. F.O.S.

N72-12589*# Massachusetts Inst. of Tech., Cambridge. Charles Stark Draper Lab.
SPACE SHUTTLE VEHICLE AUTOMATIC DOCKING STUDY Final Report
Earle P. Blanchard, Richard C. Hutchinson, and Leonard B. Johnson Oct. 1971 84 p
(Contract NAS9-10268; DSR Proj. 55-40800; Apollo Proj.)
(NASA-CR-115248; E-2606) Avail: NTIS CSCL 17G

The material presented is divided into three main areas of accomplishment. The first is a description of the angle only docking sensor concept and the computational requirements to develop useful guidance information from the raw angle only data. The second describes the analytical effort including the MIT in-house computer simulation, the development of guidance equations and vehicle stability related thereto, and presents the results of studies covering the effects of employing Kalman filtering with the sensor. The third area presents the conclusions and recommendations resulting from the program. Much of the material has appeared in previous reports, but is included here for the sake of completeness. New material indicating how the computer might operate to identify the individual sources in the target array is included. Author

N72-12590# Royal Aircraft Establishment, Farnborough (England).
A SYSTEM FOR AIRBORNE RECORDING AND ANALYSIS OF ILS LOCALISER AND GLIDE PATH INSTALLATIONS
T. R. G. Lampard Nov. 1970 60 p refs
(RAE-TR-70222) Avail: NTIS

A new measuring technique was developed for beam bending classification in instrument landing system localizers, by recording the audio output of the localizer receiver during the landing phase by means of an onboard portable magnetic tape recorder. The tape so obtained is later replayed through a specially developed analyzer, the results from which are processed on an ultraviolet recorder to give a visual record. The study shows that a measure of the order of severity of beam bends can be obtained by filtering the guidance signal in a low frequency band-pass filter (to exclude the very low frequency terms due to aircraft movement), and then integrating the mean square output of the filter over approach time. ESRO

N72-12591# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
ON THE PROBLEM OF ESTIMATING THE ATTITUDE CONTROL OF GAS JET SYSTEMS OF ANGULAR STABILIZED SPACECRAFT
I. M. Lisovitch, A. A. Bolshakov, and V. B. Zhuravlev 1971 32 p In ENGLISH and RUSSIAN
(D-59) Avail: NTIS

Recommendations are made on the application of gas jet attitude control systems for scientific spacecraft dependent on the scientific tasks to be fulfilled. The relation between the scientific tasks of the spacecraft and the requirements of the attitude control system is determined according to two main indices: accuracy of stabilization, and specific time of active performance. Attitude control systems are classified in accordance with these main indices and calculation methods are presented for certain types of systems. The elements of an attitude control system and the influence of their performance characteristics on the main system indices are examined. It is shown that the most critical point in designing the gas jet systems is the selection of the spacecraft phase state sensors and the computer. ESRO

N72-12592# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
COMPARATIVE ANALYSIS OF VARIOUS SUN ORIENTATION METHODS FOR SPACECRAFT
I. M. Lisovitch, V. V. Kastrov, and I. N. Astanina 1971 43 p refs In ENGLISH and RUSSIAN
(D-60) Avail: NTIS

General criteria for the evaluation of sun pointing systems

used for spacecraft attitude control are discussed. It is argued that their practical evaluation is difficult because currently used criteria are contradictory. The complexity of techniques employed is evaluated on the basis of the required performance characteristics of the various system elements, including optical sensors. It is concluded that the effective utilization of the different sun pointing systems is significantly dependent on the type of orbit, the number of sun pointing operations, and the spacecraft configuration. ESRO

N72-12593# Civil Aeronautics Board, Washington, D.C.
CONGRESSIONAL AIRPORT CONGESTION STUDY, PART 2
J. C. Constantz, R. J. Pellicoro, W. R. Williamson, R. J. Hilgert, W. A. Bingham, C. Hintze, R. L. Autl, W. E. Dougherty, P. S. Kozlek, and S. M. Tracy Dec. 1970 290 p
(AD-726061) Avail: NTIS CSCL 01/2

The report was prepared to provide information on principal airport congestion and its cause and effect. The study is a consolidation of information obtained from various data sources, including government and industry from which a comprehensive analysis was made to determine the probable cause and degree of air carrier delay in operations at major airports. Included in the study is an analysis of load factors and composition of passenger loads, a detailed analysis of peak period delay data and a summary of operations and delay data for the airports studied for the study timeframe. The study summarizes the probable causes of air carrier delay in operations at the major airports and recommendations to alleviate the source of delay. Author (GRA)

N72-12594# Lincoln Lab., Mass. Inst. of Tech., Lexington.
LES-8/9 ATTITUDE CONTROL SYSTEM NUMERICAL SIMULATION
Carl H. Much, Norval P. Smith, Franklin W. Floyd, and Ellen H. Swenson 5 Feb. 1971 57 p refs
(Contract F19628-70-C-0230; AF Proj. 649L)
(AD-726096; TN-1971-10; ESD-TR-71-11) Avail: NTIS CSCL 22/2

A program was written to simulate the three axis attitude control system of LES-8/9. The underlying theory to the computer simulation and detailed outlines of each of the subroutines involved in the complete program are described. Whenever feasible, the simulation was written to duplicate as closely as possible the logic and signal flow of the actual digital attitude control system. Each subroutine was thoroughly verified as accurate by independent and integral system operation, as well as by theoretical estimates, analog computer simulations and actual experimental data. A substantial compilation of data from this working program was catalogued and analyzed for attitude control system evaluation and optimization. This program also proved itself to be invaluable in the analysis of stability and performance of the complete attitude control system.
Author (GRA)

N72-12595# Air Force Packaging Evaluation Agency, Wright-Patterson AFB, Ohio.
COMPARATIVE EVALUATION OF MD-1 GYROSCOPE PACK DESIGNS
Robert E. Doolittle Jun. 1971 59 p
(AF Proj. 70-9-D-9)
(AD-725736; DSPEB-33) Avail: NTIS CSCL 17/7

The objectives of this study were to evaluate the shock protection provided by the proposed MD-1 gyroscope pack, compare its effectiveness with that of the TPO 581-2265 pack currently being used and to make recommendations concerning its acceptability as a replacement for the TPO pack. The results of this evaluation indicate that the proposed pack could be used as a replacement for the TPO pack to provide equal or greater shock protection to the gyroscope with a substantial savings in material costs. Author (GRA)

N72-12862# Technische Hochschule Stuttgart (West Germany). Inst. A fuer Mechanik.
ROTATIONAL DYNAMICS
Martin A. Frik *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1971 14 p refs (See N72-12861 03-31)
Avail: NTIS

N72-12863*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACECRAFT ATTITUDE SENSORS WITH EMPHASIS ON THE ORBITING ASTRONOMICAL OBSERVATORY
Thomas E. Huber *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1971 16 p refs (See N72-12861 03-31)
(NASA-TM-X-67384) Avail: NTIS CSCL 22B

N72-12864# Louvain Univ. (Belgium). Inst. de Mecanique.
PASSIVE AND SEMI-ACTIVE ATTITUDE STABILIZATIONS: DUAL SPIN SATELLITES
P. W. Likins and P. Y. Willems *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1971 11 p refs (See N72-12861 03-31)
Avail: NTIS

N72-12865# California Univ., Los Angeles.
PASSIVE AND SEMI-ACTIVE ATTITUDE STABILIZATIONS: FLEXIBLE SPACECRAFT
Peter W. Likins *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1971 13 p refs (See N72-12861 03-31)
Avail: NTIS

N72-12866# Royal Aircraft Establishment, Farnborough (England). Space Dept.
ACTIVE STABILIZATION
W. G. Hughes *In* AGARD Attitude Stabilization of Satellities in Orbit Sep. 1971 17 p refs (See N72-12861 03-31)
Avail: NTIS

N72-12867# Centre National d'Etudes Spatiales, Bretigny-Sur-Orge (France).
STABILIZATION OF EOLE AND PEOLE SATELLITES [STABILISATION DES SATELLITES EOLE ET PEOLE]
Philippe Huguier *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1971 28 p In FRENCH (See N72-12861 03-31)
Avail: NTIS

N72-12869# Compagnia Industriale Aerospaziale S.p.A., Rome (Italy).
THE SIRIO ATTITUDE MEASUREMENT AND CONTROL SYSTEM
Alessandro Buratti *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1971 14 p (See N72-12861 03-31)
Avail: NTIS

N72-12870# Massachusetts Inst. of Tech., Cambridge. Charles Stark Draper Lab.
ATTITUDE CONTROL OF THE APOLLO SPACECRAFT
Richard H. Battin *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1917 10 p refs (See N72-12861 03-31)
Avail: NTIS

N72-11925# Singer-Kearfott, Pleasantville, N.Y.
OPERATIONAL CONSIDERATIONS AND APPLICATIONS OF THE TALAR(R) 4 LANDING AID TO HELICOPTERS
R. Hohol and J. Taylor *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 13 p refs (See N72-11915 03-02)
Avail: NTIS

N72-11929# Societe Nationale Industrielle Aerospatiale, Paris (France).
AN AUTONOMOUS NAVIGATION SYSTEM FOR HELICOPTERS [SYSTEME DE NAVIGATION AUTONOME POUR HELICOPTERES]
M. Fourcade *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 8 p In FRENCH (See N72-11915 03-02)
Avail: NTIS

N72-11935# Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).
ADVANCED DOPPLER INERTIAL NAVIGATION SYSTEM FOR TRANSPORT HELICOPTER
V. Krogmann *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 14 p refs (See N72-11915 03-02)
Avail: NTIS

N72-11936# Mullard Research Labs., Redhill (England).
DESIGN AND EVALUATION OF A HELICOPTER GUIDANCE AID
R. N. Alcock, D. Atter, S. J. Robinsin, and R. P. Vincent *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 4 p (See N72-11915 03-02)
Avail: NTIS

N72-11938# Computing Devices of Canada, Ltd., Ottawa (Ontario).
PROJECTED MAP NAVIGATION IN MILITARY HELICOPTERS: APPLICATIONS AND OPERATIONAL EXPERIENCE
R. I. MacNab and J. C. Alexander *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 10 p refs (See N72-11915 03-02)
Avail: NTIS

N72-11939# Centre d'Essais en Vol, Bretigny-Sur-Orge (France).
EXPERIENCE OF THE FRENCH FLIGHT TEST CENTER IN ALL-WEATHER HELICOPTER LANDING [EXPERIENCE DU CENTRE D'ESSAIS EN VOL FRANCAIS DANS LE DOMAINE DE L'ATTERRISSAGE TOUT TEMPS SUR HELICOPTERE]
P. Bloch *In* AGARD Helicopter Guidance and Control Systems Sep. 1971 6 p In FRENCH (See N72-11915 03-02)
Avail: NTIS

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N72-12596 National Lending Library for Science and Technology, Boston Spa (England).
DETERMINATION OF CARBON ACTIVITIES IN LIQUID SODIUM
G. Hofer and N. Wieling 1971 8 p refs Transl. into ENGLISH of a Siemens A.G., Erlangen, West Ger. report requested by the firm Interatom as a contrib. to the proj. "Fast Sodium-Cooled Breeders" Presented at the Reactor Meeting 1971 of the Ger. Atomforum/KTG Sect. 2, 1 Apr. 1971
(NLL-Risley-Tr-2216-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

In the experiments with mass transport in sodium cooling systems, special attention must be paid to the interstitial elements B, C and N as they possess great mobility between 500 and 700C. Carbon is of particular interest because it essentially determines the strength properties of the steels used. The driving forces for carbon movement from steel into sodium, or vice versa, are chemical carbon potential differences and thus differences in the carbon activities. A summary of the carbon activities of a 18 - 9 Cr-Ni steel, the stabilizing elements Ti, Zr, V, Nb and Ta, the Armco iron and the sodium is given. Author

N72-12597*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF A HEAT REJECTION SYSTEM USING CAPILLARY PUMPING
L. G. Neal, D. J. Wanous, and O. W. Clausen Washington NASA Nov. 1971 234 p refs
(Contract NAS3-12976)
(NASA-CR-1895) Avail: NTIS CSCL 18L

Results of an analytical study investigating the application of capillary pumping to the heat rejection loop of an advanced Rankine cycle power conversion system are presented. The feasibility of the concept of capillary pumping as an alternate to electromagnetic pumping is analytically demonstrated. Capillary pumping is shown to provide a potential for weight and electrical power saving and reliability through the use of redundant systems. A screen wick pump design with arterial feed lines was analytically developed. Advantages of this design are high thermodynamic and hydrodynamic efficiency, which provide a lightweight easily packaged system. Operational problems were identified which must be solved for successful application of capillary pumping. The most important are the development of start up and shutdown procedures, and development of a means of keeping noncondensibles from the system and of earth-bound testing procedures. Author

N72-12598*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF THE METHOD OF STEEPEST DESCENT TO LAMINATED SHIELD WEIGHT OPTIMIZATION WITH SEVERAL CONSTRAINTS: THEORY
Gerald P. Lahti Washington Nov. 1971 20 p refs
(NASA-TM-X-2435; E-6542) Avail: NTIS CSCL 18F

The method of steepest descent used in optimizing one-dimensional layered radiation shields is extended to multidimensional, multiconstraint situations. The multidimensional optimization algorithm and equations are developed for the case of a dose constraint in any one direction being dependent only on the shield thicknesses in that direction and independent of shield thicknesses in other directions. Expressions are derived for one-, two-, and three-dimensional cases (one, two, and three constraints). The precedure is applicable to the optimization of shields where there are different dose constraints and layering arrangements in the principal directions. Author

N72-12599*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DYNAMICS OF HEAT-PIPE REACTORS
George F. Niederauer [1971] 11 p refs Presented at the Winter Meeting of the Am. Nucl. Soc., Miami, 17-21 Oct. 1971
(NASA-TM-X-67966; E-6678) Avail: NTIS CSCL 18L

A split-core heat pipe reactor, fueled with either U(233)C or U(235)C in a tungsten cermet and cooled by 7-Li-W heat pipes, was examined for the effects of the heat pipes on reactor while trying to safely absorb large reactivity inputs through inherent shutdown mechanisms. Limits on ramp reactivity inputs due to fuel melting temperature and heat pipe wall heat flux were mapped for the reactor in both startup and at-power operating modes. Author

N72-12600*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MINI GAS-CORE PROPULSION CONCEPT
Robert E. Hyland [1971] 14 p refs Presented at Winter Meeting of the Am. Nucl. Soc., Miami, Fla., 17-21 Oct. 1971
(NASA-TM-X-67958; E-6665) Avail: NTIS CSCL 21F

A propulsion concept is presented that can achieve specific

impulses of 1000 to 2000 seconds for thrust levels on the order of 100 pounds (445 N) and maintain a small (1.22 m) reactor diameter for a total power-plant weight of approximately 10,000 kg. The concept combines a small (0.61 m) diameter spherical gas core centrally located, followed by a moderator (BeO-15 cm), surrounded by a driver fuel region and contained in a pressure vessel (ID of 1.22 m). Best results (i.e., highest ratio of cavity power to total power) occur with U-233 isotope as the fuel in both the cavity and the driver, although U-235 can also be used. Concept may also have application in the testing of a gas-core reactor and MHD devices and in high temperature-pressure materials research. Author

N72-12601*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SHOCK AND VIBRATION TESTS OF A SNAP-8 NaK PUMP
A. J. Stromquist, R. B. Nelson (Aerojet General Corp., Azusa, Calif.), and Lawrence Hibben Oct. 1971 18 p ref
(NASA-TM-X-67945; E-6625) Avail: NTIS CSCL 18N

The pump used for reactor cooling in the SNAP 8 space power system was subjected to the expected vehicle launch vibration, and shock loading in accordance with the SNAP 8 environmental specification. Subsequent disassembly revealed damage to the thrust bearing pins, which should be redesigned and strengthened. The unit was operational, however, when run in a test loop after reassembly. Author

N72-12602*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLOW TESTS OF A SINGLE FUEL ELEMENT COOLANT CHANNEL FOR A COMPACT FAST REACTOR FOR SPACE POWER
Roy H. Springborn Oct. 1971 63 p refs
(NASA-TM-X-67955; E-6651) Avail: NTIS CSCL 18L

Water flow tests were conducted on a single-fuel-element cooling channel for a nuclear concept to be used for space power. The tests established a method for measuring coolant flow rate which is applicable to water flow testing of a complete mockup of the reference reactor. The inlet plenum-to-outlet plenum pressure drop, which approximates the overall core pressure drop, was measured and correlated with flow rate. This information can be used for reactor coolant flow and heat transfer calculations. An analytical study of the flow characteristics was also conducted. Author

N72-12603*# Arizona Univ., Tucson.
ON-LINE DIGITAL COMPUTER CONTROL OF THE NERVA NUCLEAR ROCKET ENGINE Annual Report
Larry Ellis Kendrick and Donald G. Schultz Jun. 1971 191 p refs
(Grant NGL-03-002-006)
(NASA-CR-124647) Avail: NTIS CSCL 21F

The problem of on-line digital computer control of the NERVA nuclear rocket engine is considered. Proposed is a method of State Dependent State Variable Feedback (SDSVF) as a practical approach to the control of NERVA and other complex nonlinear and/or time-varying systems. The difficulties inherent in other design methods are avoided by defining the optimal closed loop system in terms of a desired transfer function, rather than a performance index to maximize or minimize. Author

N72-12604*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AIRBREATHING NUCLEAR PROPULSION: A NEW LOOK
Frank E. Rom Washington Dec. 1971 26 p refs
(NASA-TM-X-2425; E-6316) Avail: NTIS CSCL 21F

Nuclear-powered air-cushion vehicles using lightweight aircraft-type nuclear powerplants show promise of carrying transoceanic cargo at cost-per-metric-ton-kilometer (cost-per-ton-n mi) rates comparable to railroad rates. These rates are independent of the distance traveled. Cargo rates for nonstop distances of 4000 n mi are expected to be less than one-half those for similar fossil-fueled air-cushion vehicles. For 6000-n mi nonstop distances, the rates are expected to be less than one-sixth as much. There are no fundamental technical reasons why subsonic nuclear aircraft cannot be made to fly successfully if the gross weight is over 1 million lb. Public safety of airborne nuclear powerplants is receiving the greatest attention in low-level experimental and analytical investigations. Idealized model containment vessels which have been impacted on reinforced concrete showed no leaks after impact at velocities to 400 mph. The experiments indicate feasibility of impacting at speeds over 600 mph with no leaks. Author

N72-12605*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PARAMETRIC TESTING OF AN EXTERNALLY CONFIGURED THERMIONIC CONVERTER
K. Shimada and P. Rouklovc 1 Nov. 1971 30 p refs
(Contract NAS7-100)
(NASA-CR-124576; JPL-TM-33-504) Avail: NTIS CSCL 10B

A 25.4-cm long externally configured converter was performance tested by electrically heating the emitter to simulate reactor thermal power input. The measured maximum output power was limited by the maximum input power available from the electric RF induction heater. With maximum heater input power, the converter electric output was 178 W (1.95 W/sq cm) at an emitter temperature of 1946 K. This electric output power was smaller than expected. A reactor-core-length (25.4-cm long) cylindrical thermionic converter power and maintaining the emitter-to-collector gap without shorting are of major importance to the feasibility of a 25.4-cm-long reactor fuel element. The emitter of the converter is located externally to the collector to increase the fuel-volume fraction and to allow redundant collector cooling in a reactor configuration. Author

N72-12606*# General Electric Co., Philadelphia, Pa.
POTASSIUM RANKINE CYCLE VAPOR CHAMBER (HEAT PIPE) RADIATOR STUDY
Ellsworth E. Gerrels and Robert E. Killen Washington NASA Sep. 1971 242 p refs
(Contract NAS3-10615)
(NASA-CR-1866; GESP-7047) Avail: NTIS CSCL 20M

A structurally integrated vapor chamber fin (heat pipe) radiator is defined and evaluated as a potential candidate for rejecting waste heat from the potassium Rankine cycle powerplant. Several vapor chamber fin geometries, using stainless steel construction, are evaluated and an optimum is selected. A comparison is made with an operationally equivalent conduction fin radiator. Both radiators employ NaK-78 in the primary coolant loop. In addition, the Vapor Chamber Fin (VCF) radiator utilizes sodium in the vapor chambers. Preliminary designs are developed for the conduction fin and VCF concepts. Performance tests on a single vapor chamber were conducted to verify the VCF design. A comparison shows the conduction fin radiator easier to fabricate, but heavier in weight, particularly as meteoroid protection requirements become more stringent. While the analysis was performed assuming the potassium Rankine cycle powerplant, the results are equally applicable to any system radiating heat to space in the 900 to 1400 F temperature range. Author

N72-12607# Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires.
CONTRIBUTION TO RESEARCH ON THE BEHAVIOR OF FISSION PRODUCTS IN NUCLEAR FUELS BY MEASUREMENT OF THE VAPOR PRESSURES OF THE CONSTITUENTS OF (UPu)O2 IRRADIATED IN A FAST NEUTRON FLUX Ph.D. Thesis - Paris Univ., Orsay
Matitiahv Halachmy Apr. 1971 150 p refs In FRENCH
(CEA-R-4181) Avail: AEC Depository Libraries

An apparatus to measure the vapor pressures of highly radioactive samples by Knudsen's method was designed and constructed. The fission products were classified on the basis of

their oxidation potential compared to that of the matrix and the variation of the different phases of the fuel during irradiation was estimated. The development of a chemical compound simulating a fuel irradiated up to a burn-up of 6 atomic percent demonstrated that the chemical state and the distribution of the fission products agree with prediction. The chemical and isotopic composition of fission and capture products and uranium and plutonium were calculated. The vapor pressure measurements were made between 1070 and 2320 deg K. The weights of the various elements deposited on a cooled target were determined by radiochemical analysis; counting and alpha spectrometry (Pu, Am, Cm), gamma spectrometry (Cs, Sb, Ce, Ru and Nb), beta counting (Sr). Author (NSA)

N72-12608# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
PROGRAM FOR THE OPTIMAL REACTIVITY PROFILES IN ONE-DIMENSION CYLINDRICAL REACTORS (REPO)
David Edery Mar. 1971 51 p refs In FRENCH
(CEA-N-1367) Avail: AEC Depository Libraries

The code treats the problem of the determination of the optimal distribution of reactivity in a reactor. The search for the optimal distribution is based on a stationary condition established using perturbation theory. Numerical results are presented for a two-group diffusion model in a one-dimensional cylindrical geometry. The diffusion equations are solved by a unique numerical method. Author (NSA)

N72-12609# Mound Lab., Miamisburg, Ohio.
MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: JANUARY - MARCH 1971
15 Jun. 1971 57 p refs
(Contract AT-33-1-gen-53)
(MLM-1817) Avail: NTIS

Plutonium-238 metal and dioxides are used as fuels for heat sources. Methods of preparing the fuels are being developed, and the characteristics of the fuels are being determined. The production of plutonia-molybdenum cermet (PMC) fuel discs was continued, and the fifth Pioneer capsule was fueled. Emphasis was placed on lowering the neutron emission from the final fuel discs. To achieve this, all Pu(238)O2 particles coated during the latter part of this report period were processed in the MoCl5 coating system. Spherical isotopic fuel forms are being developed to meet the design requirements of the multihundred watt heat source program. Hot pressing techniques were investigated for preparing thoria-molybdenum and plutonia-molybdenum spheres with up to 1.5 in. diameters. Three thoria-molybdenum spheres were prepared with densities up to 95% of theoretical to test die designs and hot pressing techniques. Two 87% dense plutonia-molybdenum cermet spheres were prepared using dies developed for the ThO2-Mo cermet sphere process.
Author (NSA)

N72-12610# Hanford Engineering Development Lab., Richland, Wash.
FUELS RECYCLE Quarterly Report, Jan. - Mar. 1971
Apr. 1971 46 p refs
(Contract AT(45-1)-2170)
(HEDL-TME-71-55) Avail: NTIS

Dynamic tests are being conducted in a series of miniature multistage centrifugal contactors to determine the effect of high solvent irradiation levels on solvent extraction separations process performance. No significant adverse effects were caused by solvent irradiation up to an absorbed dose of 0.04 w-hr/liter. Dissolution properties of unirradiated, mechanically blended mixed oxide fuel were investigated. The projected performance of electrolytic dissolvers is being analyzed for LMFBR fuels. Dosimetry measurements were made on a completed FFTF-type fuel subassembly, both with and without the flow duct in place. Neutron yields from PuC in a PuC-UC mixture were about 22% higher than from PuO2 of similar isotopic composition in a PuO2-UO2 mix. A study is underway to evaluate the dose to the forearm through the hood gloves on a UO2-PuO2 fuel fabrication line. NSA

N72-12611# Gulf Radiation Technology, San Diego, Calif.
DEVELOPMENT AND VERIFICATION OF DESIGN METHODS FOR DUCTS IN A SPACE NUCLEAR SHIELD, PHASES 4 AND 5 Final Report
R. J. Cerbone and P. A. Read 31 Mar. 1971 144 p refs
(Contract AT(04-3)-167)
(Gulf-RT-10577) Avail: NTIS

In the reference NERVA reactor, a light-weight shield, made of neutron and gamma attenuating material, is located above the reactor core support plate as a central shield and above the reflector as an extension shield. The material is composed of boron carbide, aluminum, and titanium hydride (BATH). Approximately 6000 small diameter (less than 0.2 inch) coolant holes in line with the core penetrate the shield. Thirty piping penetrations (approximately 1 inch diameter) are located in the peripheral shield through which hydrogen flows to the support plate system. A study to measure and calculate neutron streaming with the holes penetrating the peripheral shield is described. The study included: (1) development of the DUCT code to include the treatment of multiple ducts, a DASH flux input option, and the use of coupled neutron gamma ray transfer cross sections; and (2) extend an experimental-analytical comparison to include neutron and secondary gamma production and transport in a NERVA-BATH shield assembly. NSA

N72-12612# Oak Ridge National Lab., Tenn.
OPTIMIZATION OF A SHIELD FOR A HEAT PIPE COOLED FAST REACTOR DESIGNED AS A NUCLEAR ELECTRIC SPACE POWER PLANT
W. W. Engle, Jr., R. L. Childs, F. R. Mynatt, and S. Lorraine
15 Jun. 1971 41 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3449) Avail: NTIS

An optimization procedure based on the ASOP shield optimization computer code and the DOT radiation transport code was used to determine a minimum-weight shield for a small fast reactor designed for a space nuclear electric power plant. The cylindrical reactor, is fueled with UN and cooled by liquid K circulating through a matrix of stainless steel heat pipes embedded in the core; the design power is 450 kW(t). The surrounding shield is typically asymmetric. The dose constraints are 3 mrem/hr at all 100-ft radii falling within the shadow cast by the base of the cone and 300 mrem/hr at all other 100-ft radii. The optimized shield consists of alternate layers of W and LiH, the thick bottom section extending out to a radius of 112 cm and the tapered side decreasing to a radius of 89 cm. The top heat-pipe shield region consists of a 59-cm-thick inner layer of a stainless-steel-B4C mixture and a 30.5-cm-thick outer layer of a BeO-B4C mixture. The total shield weight is 25,589 lb. A partially optimized shield has a total weight of 14,708 lb. These shield weights include an allocation for 3.5 vol% of stainless steel structure in the LiH regions. Author (NSA)

N72-12613# Kernforschungszentrum, Karlsruhe (West Germany).
TRACE DETERMINATION IN NUCLEAR FUELS BY EMISSION SPECTROSCOPY
E. Mainka and H. G. Mueller [1971] 37 p Transl. into ENGLISH from the German report KFK-1261
(EURFNR-852; KFK-1261) Avail: NTIS

Two quantitative analytical methods using emission spectroscopy are described. These methods are applied on a routine basis for acceptance controls of plutonium-bearing nuclear fuels. Up to 17 trace impurities can be determined in a simple analytical run. To minimize spectral interferences separation between matrix and impurities is needed. Separation is achieved by ion exchange on the one hand and by pre-evaporation on the other. As a result, the detection efficiencies were significantly increased for most trace elements as compared to the direct methods. Attention was given to the preparation of standard samples. It can be demonstrated that it was possible to use commercially available U3O8 standard samples Nr. 95 (1-7) for the determination of impurities. Author (NSA)

N72-12614# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
RESEARCH IN THE METALLURGICAL DEPARTMENT DURING 1970
Gerard Cabane May 1971 19 p In FRENCH
(CEA-N-1436) Avail: AEC Depository Libraries

Fundamental and applied research in metallurgy is described. The applied research was aimed at improving the behavior, under irradiation, of alloys used in reactor cores as fuels (uranium alloys), or as cans or structural elements (steels, magnesium and zirconium alloys). The construction of vessels and integrated heat exchangers also presented metallurgical problems. The fundamental research performed in the same department concerned the principal problems of nuclear metallurgy (irradiation damage) and classical metallurgy (surfaces and interfaces and plastic deformation). No attempt was made to investigate a particular practical problem, but rather, to describe the atomic defects and mechanisms which manifest themselves in the macroscopic effects observed by metallurgists.
Author (NSA)

N72-12615# Oak Ridge National Lab., Tenn.
DESCRIPTION OF EBR-2 SUBASSEMBLY X-100
E. E. Bloom, J. W. Woods, and A. F. Zulliger Jun. 1971 30 p ref
(Contract W-7405-eng-26)
(ORNL-TM-3389) Avail: NTIS

The experiment was designed to investigate the effects of preirradiation microstructure, alloy composition, irradiation temperature, and fast neutron fluence on the physical and mechanical properties of austenitic steels. Alloys included in the experiment are Types 304, 316, and 318 stainless steels; Types 304 and 316 stainless steels modified by altering the amounts of Mo, Ti, and C; SANDVIK 12R72HV; and 19-9-DL. The experiment was installed in the reactor grid position 2D1 of the EBR-2 and is designated subassembly X-100. Author (NSA)

N72-12616# Scientific Translation Service, Ann Arbor, Mich.
SGCR-GC CENTRIFUGAL EXTRACTOR TESTS
Jun. 1971 11 p refs Transl. into ENGLISH from SGCR-GC-Essais d'Extracteurs Centrifuges, French report CEA-N-1241, sect. 7.8 p 241-254 Sponsored by AEC Prepared for ANL
(STS Order 10573(b); Purchase Order 684215)
(ANL-Trans-885; CEA-N-1241; Letter-release-27) Avail: NTIS

Experiments carried out on the dissolution, after boring of Sicral fuels with a graphite core, are reported. In order to increase the decontamination during the reprocessing of fuels by the Purex method, the effects of sulfate and molybdenum ions on the formation of zirconium butyl phosphates were studied. The distribution coefficients of Pu, Zr, Nb, and Ru in the mixture TBP-dodecane were determined with a view to reprocessing Pu-Al fuels. Tests were performed on the application of the fluorine method to remove interphase precipitates. The distribution coefficients of HF in the mixture TBP-dodecane and the distillation of fluorine during the concentration of fission products were studied: aromatic hydrocarbons were used as tridodecylamine diluent. Author (NSA)

N72-12617# Los Alamos Scientific Lab., N.Mex.
Pu-238 SPACE ELECTRIC POWER FUEL DEVELOPMENT PROGRAM Quarterly Status Report, 1 Oct. - 31 Dec. 1970
Jun. 1971 17 p
(Contract W-7405-eng-36)
(LA-4697) Avail: NTIS

Efforts during the report period were devoted mostly to development of PuO2-Mo fuel disks. Development studies were initiated in support of heat sources using (Pu-238)O2/ThO2 fuels. Data used in characterization of PuO2-Mo cermets are included. NSA

N72-12618# California Univ., Livermore. Lawrence Radiation Lab.
THERMONUCLEAR REACTORS, MIRROR MACHINES AND DIRECT CONVERSION
R. W. Werner 25 Jan. 1971 62 p refs Presented at Direct Energy Conversion Short Course Conf., Tempe, Ariz., 25-28 Jan. 1971 Submitted for publication Sponsored by AEC
(UCRL-72969; Conf-710109-1) Avail: NTIS

Basic plasma physics principles are reviewed. The main approaches for controlled fusion are briefly described. The use of a direct energy converter in conjunction with magnetic mirrors is described in some detail. The advantages are pointed out. NSA

N72-12619# Los Alamos Scientific Lab., N.Mex.
METHODS OF CHEMICAL ANALYSIS FOR FBR URANIUM-PLUTONIUM OXIDE FUEL AND SOURCE MATERIALS
James E. Rein, George M. Matlack, Glenn R. Waterbury, Robert T. Phelps, and Charles F. Metz, eds. Feb. 1971 155 p refs
(Contract W-7405-eng-36)
(LA-4622) Avail: NTIS

Twenth four methods are given for the chemical specification analysis of FBR uranium-plutonium mixed oxide fuel and uranium dioxide insulator pellets, and for the source materials of ceramic grade uranium dioxide and plutonium dioxide used for their manufacture. The methods include dissolution procedures, uranium and plutonium assay, uranium and plutonium isotopic abundances, metal and nonmetal impurities, and other specifications relating to total gas, water, and the oxygen-to-metal ratio. Author (NSA)

N72-12620# Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Plants Div.
TEMPERATURE FIELD IN A FUEL ELEMENT WITH THE ARBITRARY DISTRIBUTION OF HEAT SOURCES
A. Krettova 1971 20 p
(ZJE-100) Avail: AEC Depository Libraries

The method of determining the distribution of rods in an A-1 power station type fuel element with the aim of flattening the gradient of fuel surface temperature in radial direction is described. The method of fuel element temperature field calculation with other than cosine axial distribution of the neutron flux is discussed. The effect of this distribution on the basic thermal parameters of the element and the thermal efficiency is investigated. The results are compared with a case of cosine distribution of heat sources along the fuel element height used in current calculations of heat removal from the reactor core.
Author (NSA)

N72-12621# General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation.
THERMAL RESPONSE AND CLADDING PERFORMANCE OF AN INTERNALLY PRESSURIZED ZIRCALOY-CLAD, SIMULATED BWR FUEL BUNDLE COOLED BY SPRAY UNDER LOSS OF COOLANT CONDITIONS
J. D. Duncan and J. E. Leonard Apr. 1971 149 p refs
(Contract AT(10-1)-1230)
(GEAP-13112) Avail: NTIS

The first full length, electrically heated, 49-rod, Zircaloy-clad simulated BWR fuel bundle with internally pressurized rods was spray cooled under loss-of-coolant conditions. The heater rods were internally pressurized with argon to simulate fission product gas inventory. The temperature response, perforation, and oxidation of the bundle cladding are described. Many perforations and severe rod distortions occurred near the center of the bundle. Author

N72-12622# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
COBRA-3: A DIGITAL COMPUTER PROGRAM FOR STEADY STATE AND TRANSIENT THERMAL-HYDRAULIC ANALYSIS OF ROD BUNDLE NUCLEAR FUEL ELEMENTS
D. S. Rowe [1971] 77 p refs
(Contract AT(45-1)-1830)

(BNWL-B-82) Avail: NTIS

The COBRA-II computer program computes the flow and enthalpy in rodbundle nuclear fuel element subchannels during both steady state and transient conditions. It uses a mathematical model that considers both turbulent and diversion crossflow mixing between adjacent subchannels. Each subchannel is assumed to contain one-dimensional, two-phase slip-flow. The two-phase flow structure is assumed to be fine enough for local void fraction to be a function of enthalpy, flow rate, heat flux, pressure position and time. Steady-state two-phase flow correlations are assumed to apply to transients. The mathematical model neglects sonic velocity propagation; therefore, it is limited to transients where the transient times are greater than the time for a sonic wave to pass through the channel. Author (NSA)

N72-12623# Oak Ridge National Lab., Tenn.

PERFORMANCE OF SPHERE-PAC AND PELLETIZED (U,Pu)O2 DURING SEVERE OVERPOWER TRANSIENTS

C. M. Cox Jul. 1971 30 p refs Presented at the Conf. on Fast Reactor Fuel Element Technol., New Orleans, 13-15 Apr. 1971

(Contract W-7405-eng-26)

(ORNL-TM-3384; Conf-710414-8) Avail: NTIS

Six fuel pins containing unirradiated sol-gel-derived (U,Pu)O2 were subjected to power transients at the Transient Reactor Test Facility. No failure occurred even though 50 vol % of the fuel melted in the peak power regions of two Sphere-Pac pins. Neutron radiographic and destructive examinations showed extensive fuel relocation within the cladding. This included fuel column separations, fuel densification during cooling from a molten state, and axial migration of fuel and perhaps of large bubbles of adsorbed gases in the molten fuel. There was evidence that a gap formed between the Sphere-Pac fuel and cladding. The influence of fuel column separations on length changes tended to be offset by sintering and shrinkage. Pellet fuel pins showed occasional separations at pellet interfaces. Comparison with other data indicates that, for the types of transients considered, there is no difference between the performance of pellet or Sphere-Pac fuel of the same smear density and sol-gel and coprecipitated pellets behave equivalently. Author (NSA)

N72-12624# Oak Ridge National Lab., Tenn.

KINETIC MODELS FOR THE SYNTHESIS OF (U,Pu)O(2-y) BY HYDROGEN REDUCTION AND CARBOTHERMIC TECHNIQUES

T. B. Lindemer and R. A. Bradley [Apr. 1971] 35 p refs Presented at the 73d Ann. Meeting of the Am. Ceramics Soc., Chicago, Ill., 24-29 Apr. 1971 Submitted for publication

(Contract W-7405-eng-26)

(ORNL-TM-3358; CONF-710415-2) Avail: NTIS

Three models were developed that permit the calculation of the time necessary for the synthesis of hypostoichiometric oxide from (U,Pu)O2. The models are based on the interrelation between oxygen potential, valence of plutonium, and temperature determined by Rand and Markin and on the experimental conditions for reduction. Two reduction techniques are considered: the flowing hydrogen system and the C-CO-CO2 system. At the usual temperatures for reduction, the partial pressure of water, the hydrogen flow, and the total weight of oxide are the most important factors in the hydrogen system, while in the C-CO-CO2 system the important factors are the weight of the oxide in each oxide pellet, the partial pressure of carbon monoxide, the proximity of the oxide and the carbon used for reduction, and the minimum oxygen-to-metal ratio possible at the oxygen potential of the C-CO-CO2 equilibrium. Author (NSA)

N72-12625# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Reactors Div.

SENSITIVITY OF FUEL PIN BEHAVIOR TO VOID SWELLING AND IRRADIATION CREEP OF STAINLESS STEEL

A. Boltax, T. P. Soffa, and A. Biancheria [1971] 5 p refs

(Contract AT(30-1)-4210)

(TID-25756) Avail: NTIS

Analytical studies of the behavior of stainless steel clad, mixed oxide fuel pins with the OLYMPUS and CYGRO-F computer codes revealed the significance of void swelling and irradiation creep of stainless steels on the burnup capability of this LMFBR fuel system. These studies revealed the major effects of fuel pellet and/or fuel smear density, fluence-to-burnup ratio, and cladding temperature on the dimensional behavior of fuel pins. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N72-12626*# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Physics.

PROXIMITY EFFECT BETWEEN SUPERCONDUCTING AND NORMAL METALS Semiannual Report

Hans Meissner Oct. 1971 18 p refs

(Grant NGL-31-003-020)

(NASA-CR-124627; SIT-P263(10/71)) Avail: NTIS CSCL 20L

Electrical characteristics of thin films of tin vapor deposited on gold substrates are described. Favorable characteristics of these films include: (1) shiny and smooth finishes; (2) higher Josephson critical currents; (3) smaller electronic mean paths; and (4) consistent current-voltage curve shapes. One unfavorable characteristic is a much steeper increase of the Josephson critical current with decreasing temperature. The functional variation of the Josephson current with the control current is described. Two functional forms have been observed and a brief description as to possible mechanisms for this behavior have been included. Author

N72-12627*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE EFFECT OF ROCKET PLUME CONTAMINATION ON THE OPTICAL PROPERTIES OF TRANSMITTING AND REFLECTING MATERIALS

John R. Jack, Ernie W. Spisz, and John F. Cassidy [1971] 8 p refs Presented at 10th Aerospace Sci. Meeting, San Diego, Calif., 17-19 Jan. 1972; sponsored by AIAA

(NASA-TM-X-67974) Avail: NTIS CSCL 20F

The preliminary results of plume contamination from a 5-pound thrust single-doublet, bipropellant rocket engine on the transmittance of quartz and the reflectance of a silicon monoxide overcoated aluminum mirror are presented. Changes in quartz transmittance were found to be significant and were due to both absorption and scattering effects. Contaminant absorption effects were predominant at the short wavelengths and scattering effects were greatest in the visible wavelengths. Measured changes in mirror reflectance were due primarily to contaminant absorption. Scattering effects were found to be as much as 9 percent of the total reflected energy from the mirror. There were no noticeable chemical or erosion effects on either the quartz or the front surface mirror. Author

N72-12628*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A MODEL FOR THE ACOUSTIC IMPEDANCE OF A PERFORATED PLATE LINER WITH MULTIPLE FREQUENCY EXCITATION

Edward J. Rice 1971 18 p refs Presented at the Acoustical Soc. of Am., Denver, 19-22 Oct. 1971

(NASA-TM-X-67950; E-6636) Avail: NTIS CSCL 20A

A nonlinear resistance model is used in the one-dimensional

equations of motion with an arbitrary exciting pressure function. The effects of high amplitude fluid motion, grazing flow, and spectral excitation can be studied together. Sample calculations of acoustic resistances are presented using a high amplitude discrete tone superimposed upon a simulated white noise spectrum. The tone amplitude is varied and its effect is shown both with and without a grazing flow velocity. Author

N72-12629*# Hale Observatories, Pasadena, Calif. Big Bear Solar Observatory.
INTENSITY OSCILLATION IN H ALPHA-FINE STRUCTURES
Arvind Bhatnagar and Katsuo Tanaka [1971] 22 p refs
(Grant NGR-05-002-071)
(NASA-CR-123479) Avail: NTIS CSCL 20F

Using a new technique of directly measuring the intensity variation from the 16mm time-lapse filtergram movies taken in the blue wing and in the line center of H-alpha, periodic intensity oscillations were found in the center of H-alpha supergranulation network, in rosette centers, and in plage granules. The oscillatory period of intensity in the network is of the order of 170 + or - 44 seconds while in regions of stronger magnetic field, such as in plages and in rosettes, the period was found to be longer, on the order of 300 + or - 50 seconds. It is suggested that observed intensity oscillation in the rosette center is related to the shooting out of dark mottles from rosettes. Oscillatory intensity fluctuations were also observed in the sunspot umbra. Author

N72-12630*# General Dynamics/Fort Worth, Tex. Convair Aerospace Div.
SPECTROGRAPHIC STUDIES: ELECTRON INDUCED LUMINESCENCE IN OPTICAL MATERIALS Contract Report, 15 Apr. 1969 - 15 Apr. 1971
John Romanko, J. K. Miles, and P. R. Cheever Dec. 1971 66 p refs Supplement Rept. "Spectrographic Studies of Luminescence in Charged-Particle-Irradiated Optical Materials," NASA-CR-66758, 21 Mar. 1969
(Contract NAS1-7734)
(NASA-CR-1921; FZK-376) Avail: NTIS CSCL 20F

The spectral luminescence induced in UV grade sapphire, MgF2 and LiF2, three fused silicas, and three Corning glasses, by 1/2, 1, 2, and 3 MeV electrons was recorded. In the wavelength range from the LiF UV cutoff to the near visible, a plane-grating spectrograph with photographic recording at resolutions of 0.8 and 1.6 nm was utilized. Qualitative results based on relative density tracings of seven of the nine materials obtained from preliminary plates are given. Author

N72-12631*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A METHOD OF TREATING THE NON-GREY ERROR IN TOTAL EMITTANCE MEASUREMENTS
James B. Heaney and John H. Henninger Washington Dec. 1971 13 p refs
(NASA-TN-D-6501; G-1026) Avail: NTIS CSCL 20F

In techniques for the rapid determination of total emittance, the sample is generally exposed to surroundings that are at a different temperature than the sample's surface. When the infrared spectral reflectance of the surface is spectrally selective, these techniques introduce an error into the total emittance values. Surfaces of aluminum overcoated with oxides of various thicknesses fall into this class. Because they are often used as temperature control coatings on satellites, their emittances must be accurately known. The magnitude of the error was calculated for Alzak and silicon oxide-coated aluminum and was shown to be dependent on the thickness of the oxide coating. The results demonstrate that, because the magnitude of the error is thickness-dependent, it is generally impossible or impractical to eliminate it by calibrating the measuring device. Author

N72-12632# Centre National d'Etudes Spatiales, Paris (France).
SECOND SYMPOSIUM ON OPTICS [DEUXIEMES JOURNEES D'OPTIQUE]
1969 390 p refs In FRENCH Proc. of the Symp. held in Marseille, 23-25 Sep. 1969
Avail: NTIS HC $6.00/MF $0.95

Conference papers on optical equipment in relation to the French space program are presented. For individual titles, see N72-12633 through N72-12656.

N72-12633# Centre National d'Etudes Spatiales, Bretigny-Sur-Orge (France).
REPORT OF CNES ACTIVITIES IN THE FIELD OF INSTRUMENTATION [PRESENTATION DES ACTIVITES DU CNES DANS LE DOMAINE DE L'INSTRUMENTATION] c14
P. Rousseau *In its* 2nd symp. on optics 1969 p 1-10 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

In this introduction on optical equipment in relation to the French space program, the broad lines of the program are presented. Thin film optics, optical detectors, gratings materials, and instruments are included. ESRO

N72-12634# Societe d'Etudes et d'Application de Vide Optique et Mecanique, Argenteuil (France).
STUDY AND FABRICATION OF THIN FILMS FOR THE FAR ULTRAVIOLET BETWEEN 1200 AND 2500 A [ETUDE ET FABRICATION DE COUCHES MINCES POUR L'ULTRAVIOLET LOINTAIN DE 1200 A 2500 A] c14
A. Malherbe *In* CNES 2nd Symp. on Optics 1969 p 11-20 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

Research and development of mirrors having high reflection factors and interference filters for wavelengths greater than 1025 A are reported. Fabrication methods, particularly the control of thickness of the layer, are discussed, and the results presented. ESRO

N72-12635# Aix-Marseilles Univ. (France). Lab. d'Optique.
OPTICAL AND MICROGRAPHIC STUDY OF MIRRORS AND GRATINGS FOR USE IN THE FAR ULTRAVIOLET [ETUDE OPTIQUE ET MICROGRAPHIQUE DE MIROIRS ET DE RESEAUX TRAITES POUR L'UVL]
C. Laurent (CNRS, Verrieres-le-Buisson, France), A. Fornier, and M. Passerel *In* CNES 2nd Symp. on Optics 1969 p 21-29 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

Optical characteristics in the spectral range 1200 to 1500 A for beryllium and titanium mirrors coated with aluminum-magnesium fluoride and for several different diffraction gratings are discussed. The behavior of some of these gratings is analyzed using an original electron microscopy technique. It is shown that the optical properties of the gratings can be linked to their shape, profile, and surface state. ESRO

N72-12636# Jobin et Yvon S. A., Arcueil (France).
HOLOGRAPHIC DIFFRACTION GRATINGS [RESEAUX DE DIFFRACTION HOLOGRAPHIQUES] c06
G. Pieuchard, J. Flamand, J. Cordelle, and A. Labeyrie (Paris Obs.) *In* CNES 2nd Symp. on Optics 1969 p 30-41 refs In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

A photochemical process was developed which avoids the drawbacks of photographic methods for the manufacture of gratings to be used with coherent light. Excellent quality gratings are obtained. The manufacture of improved gratings is described, including focusing gratings, stigmatic concave gratings with wide aperture, and corrective gratings. ESRO

N72-12637# Centre National d'Etudes Spatiales, Paris (France). Lab. de Technologie Optique.
MEASUREMENT OF THE EFFICIENCY OF GRATINGS [MESURE DE L'EFFICACITE DES RESEAUX]

M. Duban *In its* 2nd Symp. on Optics 1969 p 42-51 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

The efficiency of gratings can be computed but the results must be compared with experimental data because of the role played by antifacets. Global and local measurement of grating efficiency is discussed, and the best conditions for such measurements are determined. ESRO

N72-12638# Centre National d'Etudes Spatiales, Paris (France). Lab. de Technologie Optique.
MEASUREMENT OF THE TRANSMISSIVITY AND REFLECTANCE FACTORS OF MATERIALS FOR RADIATION FROM LYMAN ALPHA TO THE VISIBLE WAVELENGTH [MESURE DES FACTEURS DE TRANSMISSION ET DE REFLEXION DES AMTERIAUX POUR DES RADIATIONS ALLANT DE LYMAN ALPHA AU VISIBLE]
G. Waultier *In its* 2nd Symp. on Optics 1969 p 52-59 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

Methods for measuring transmissivity and reflectivity of materials over a wide range of radiation from Lyman alpha to visible radiations are described. They are based on a comparison of the measured light flux and the flux of the same light beam after reflection on or absorption through the materials to be tested. With ultraviolet radiation, several difficult problems were met as the operation was carried out in vacuum. ESRO

N72-12639# Compagnie Francaise Thomson Houston-Hotchkiss Brandt, Paris.
IMAGE INTENSIFIER TUBES: SUPER VIDICON [LES TUBES DE PRISES DE VUES A INTENSIFICATION D'IMAGE: LE SUPER VIDICON] **c14**
M. Blamoutier *In* CNES 2nd Symp. on Optics 1969 p 60-58 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

An image intensifier with diode-type glass fiber optics is described, and its performance is evaluated. Signal-to-noise ratio, resolution and the influence of the components are discussed. ESRO

N72-12640# Paris Observatory, Meudon (France).
ELECTRONIC CAMERA FOR SPACE RESEARCH [CAMERA ELECTRONIQUE POUR LA RECHERCHE SPATIALE] **c14**
Jean Guerin *In* CNES 2nd Symp. on Optics 1969 p 69-75 refs In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

Some improvements were made to the original design for balloon-borne experiments, in particular by the use of a liquid helium cryostat in which the electro-optical equipment is immersed. ESRO

N72-12641# Compagnie Generale d'Electricite, Paris (France). Lab. de Narcoussis.
CHARACTERISTICS OF MAGNESIUM AND LITHIUM FLUORIDE CRYSTALS [CARACTERISTIQUES DES CRISTAUX DE FLUORURE DE MAGNESIUM ET DE FLUORURE DE LITHIUM]
G. Petitjean *In* CNES 2nd Symp. on Optics 1969 p 76-82 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

Magnesium and lithium fluoride single crystals were grown. Their transmissivity for lyman alpha radiation is discussed; it is found that their transmissivity decreases rapidly after exposure to the atmosphere. ESRO

N72-12642# Compagnie des Compteurs, Montrouge (France).
A NEW THERMOPILE DETECTOR FOR USE IN AN INFRARED HORIZON SCANNER FOR SYNCHRONOUS SATELLITES [NOUVEAU DETECTEUR DU SENSEUR D'HORIZON INFRAROUGE A THERMOPILE POUR LES SATELLITES GEO-STATIONNAIRES] **c14**
V. Volkovisky *In* CNES 2nd Symp. on Optics 1969 p 84-113 ref In FRENCH (See N72-12632 03-23) Avail: NTIS HC $6.00/MF $0.95

An infrared horizon scanner was designed for synchronous satellite attitude control. The efficiency of the system is discussed. ESRO

N72-12643# Laboratoires d'Electronique et de Physique Appliquee, Limeil-Brevannes (France).
HORIZON SCANNERS [SENSEURS D'HORIZON] **c14**
F. Desvignes *In* CNES 2nd Symp. on Optics 1969 p 114-127 In FRENCH Sponsored in part by CNES, Lab. de Rech. Balistiques et Aerodyn. and ESRO (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

Different types of infrared horizon sensors are reviewed. Their technology and performances are discussed. Special attention is paid to spin and three-axes stabilized satellites and to static sensors. ESRO

N72-12644# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
SYSTEM FOR MEASURING INFRARED RADIATION BY MEANS OF A PNEUMATIC DETECTOR FOR USE ON ROCKETS AND SATELLITES [CHAINE DE MESURE DE RAYONNEMENT INFRAROUGE AVEC DETECTEUR PNEUMATIQUE UTILISABLE SUR FUSEES ET SATELLITES] **c14**
M. Chatanier and G. Gauffre *In* CNES 2nd Symp. on Optics 1969 p 128-132 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

A miniature infrared transducer is described. Incoming radiation is transformed into heat on a gold thin film. The surrounding gas (xenon) is heated and expands deforming a membrane which constitutes an electrode of a variable capacitor. The output signal is proportional to the variation of capacity. The device was used successfully in scientific experiments carried from aircraft, balloons, and sounding rockets. ESRO

N72-12645# Engins Matra, Velizy (France).
THE MATRA ONBOARD CAMERA [CAMERA EMBARQUABLE MATRA] **c14**
J. Hascoet *In* CNES 2nd Symp. on Optics 1969 p 133-139 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

A television camera was designed for spaceborne application. It was built with a half-inch vidicon, and a control circuit provides for automatic adjustment. ESRO

N72-12646# Centre National de la Recherche Scientifique, Verrieres-Le-Buisson (France). Service de Technologie Spatiale.
PRINCIPAL ACHIEVEMENTS OF THE SECTION "PHYSIQUE DEVELOPMENT" [PRINCIPALES REALISATIONS DE LA SECTION PHYSIQUE DEVELOPPEMENT] **c14**
J. Denis *In* CNES 2nd Symp. on Optics 1969 p 140-150 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

The main activity was to design and develop instruments used with ultraviolet radiation, particularly in the Lyman alpha region. Some of these developments are presented, including absorption and resonance bottles, calibrating sources, and helium transparent thin windows. ESRO

N72-12647# Centre National de la Recherche Scientifique, Verrieres-Le-Buisson (France). Service de Technologie Spatiale.
SPACEBORNE METAL VAPOR SPECTRAL SOURCES [SOURCES SPECTRALES EMBARQUABLES A VAPEUR METALLIQUE] **c24**
D. Bauduin *In* CNES 2nd Symp. on Optics 1969 p 151-153 In FRENCH (See N72-12632 03-23)

Avail: NTIS HC $6.00/MF $0.95

A cadmium vapor spectral source is described, including a heating device and circuits. Heating is provided by an argon discharge lamp. ESRO

N72-12648# Centre National de la Recherche Scientifique, Verrieres-Le-Buisson (France). Service de Technologie Spatiale.
LUMINESCENT CALIBRATION SOURCE [SOURCE DE CALIBRATION A LUMINESCENCE] c14
A. Rouscilles *In* CNES 2nd Symp. on Optics 1969 p 154-156 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

A photoluminescent calibrated ultraviolet radiation source was developed using both photo and cathode luminescence. A mercury vapor discharge tube was used. Two magnesium fluorite windows are provided, one of which is coated with a photoluminescent deposit so that the source may be used for reflection or transparency studies. ESRO

N72-12649# Centre National de la Recherche Scientifique, Marseilles (France). Lab. d'Astronomie Spatiale.
DEVELOPMENT OF A HIGH TEMPERATURE BLACK BODY BY MEANS OF HIGH FREQUENCY HEATING [REALISATION D'UN CORPS NOIR A HUATE TEMPERATURE PAR CHAUFFAGE A HAUTE FREQUENCE]
Chon Trung Hua *In* CNES 2nd Symp. on Optics 1969 p 157-159 refs In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

A black body, which constitutes a universal standard, emits an energy spectrum, the maximum of which will tend towards shorter waves the higher the temperature of the black body. A black body obtained by induction heating of a graphite crucible is described. Results gained are presented, and the oven performance is discussed. ESRO

N72-12650# Centre National de la Recherche Scientifique, Marseilles (France). Lab. d'Astronomie Spatiale.
DEVELOPMENT OF 50 mm SCHMIDT LAMINA [FABRICATION DE LAME DE SCHMIDT DE DIAMETRE: 50 mm]
A. Baranne, M. Detaille, G. Lemaitre, and G. Moreaux *In* CNES 2nd Symp. on Optics 1969 p 172-177 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

The fabrication of Schmidt lamina for correcting spherical and chromatic aberration of wide mirrors used in Cassegrain telescopes is discussed. Lamina are placed on a support, and a vacuum is created beneath before grinding. ESRO

N72-12651# Paris Univ., Orsay (France). Inst. d'Optique.
RECENT DEVELOPMENTS IN THE FIELD OF ASPHERIC SURFACES [REALISATIONS RECENTES DANS LE DOMAINE DES SURFACES ASPHERIQUES] c16
J. P. Marioge *In* CNES 2nd Symp. on Optics 1969 p 178-186 ref In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

The fabrication of aspheric lenses to be used for laser beams is discussed. Two examples are used: wide angle eyepiece and a wide angle light condenser for laser application. ESRO

N72-12652# Centre National d'Etudes Spatiales, Paris (France). Lab. de Technologie Optique.
MEASUREMENTS ON PHOTOMULTIPLIERS [MESURES SUR LES PHOTOMULTIPLICATEURS] c09
D. Husson *In its* 2nd Symp. on Optics 1969 p 187-194 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

The sensitivity of photomultiplier tubes is discussed. A measuring and calibrating device is analyzed which uses a modulated light beam and an amplifier synchronized with the modulation frequency. ESRO

N72-12653# Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
STUDY ON AN ELECTRON PHOTOMULTIPLIER TUBES WITHOUT WINDOW [ETUDE DU MULTIPLICATEUR TUBULAIRE D'ELECTRONS SANS FENETRE] c09
C. Barat *In* CNES 2nd Symp. on Optics 1969 p 195-211 refs In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

The essential characteristics and reliability of photomultiplier tubes are briefly described. The variation of gain as a function of temperature is analyzed. ESRO

N72-12654# Direction des Recherches et Moyens d'Essais, Paris (France).
PRINCIPLES OF FUNCTIONING OF DIFFERENT IMAGE TUBES [LES PRINCIPES DE FONCTIONNEMENT DES DIFFERENTS TUBES A IMAGES] c09
Corfdir *In* CNES 2nd Symp. on Optics 1969 p 212-225 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

The photoelectric emission of photocathodes, photoconduction of semiconductor layers, and the evolution of the potential of a target submitted to electron bombardment are discussed. Electrostatic and electromagnetic image formation are analyzed. ESRO

N72-12655# Centre National de la Recherche Scientifique, Verrieres-Le-Buisson (France). Service de Technologie Spatiale.
IMAGE CONVERTERS [LES CONVERTISSEURS D'IMAGE] c09
P. Balaskovic *In* CNES 2nd Symp. on Optics 1969 p 226-249 refs In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

Different types of image converters are discussed, and their gain, resolution, and image contrast are also analyzed. ESRO

N72-12656# Centre National de la Recherche Scientifique, Marseilles (France). Lab. d'Astronomie Spatiale.
THE VIDICON AS A PHOTOMETRIC MEASURING APPARATUS: NUMERICAL PROCESSING OF IMAGES [LE VIDICON COMME APPAREIL DE MESURE PHOTOMETRIQUE: TRAITEMENT NUMERIQUE DES IMAGES] c14
A. ILebaria and A. Roussin *In* CNES 2nd Symp. on Optics 1969 p 250-267 refs In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

Some aspects of information theory are recalled. The celoscope photometric system onboard the OAO and the television camera onboard Surveyor 7 are discussed. Photometric measurement with this camera and the digital image processing are analyzed including linear filtering. ESRO

N72-12657*# Ohio State Univ. Research Foundation, Columbus.
COMPARISON OF VARIOUS METHODS FOR MATHEMATICAL ANALYSIS OF THE FOUCAULT KNIFE EDGE TEST PATTERN TO DETERMINE OPTICAL IMPERFECTIONS
B. E. Gatewood Washington NASA Nov. 1971 105 p refs (Grant NGR-36-008-153; RF Proj. 3050-A1) (NASA-CR-1906) Avail: NTIS CSCL 17H

The linearized integral equation for the Foucault test of a solid mirror was solved by various methods: power series, Fourier series, collocation, iteration, and inversion integral. The case of the Cassegrain mirror was solved by a particular power series method, collocation, and inversion integral. The inversion integral method appears to be the best overall method for both the solid and Cassegrain mirrors. Certain particular types of power series and Fourier series are satisfactory for the Cassegrain mirror. Numerical integration of the nonlinear equation for selected surface imperfections showed that results start to deviate from those given by the linearized equation at a surface deviation of about 3 percent of the wavelength of light. Several possible procedures for calibrating and scaling the input data for the integral equation are described. Author

N72-12658*# California Univ., La Jolla. Dept. of Applied Physics and Information Sciences.
THE APPLICATION OF SIGNAL DETECTION THEORY TO OPTICS Semiannual Status Report, 15 Mar. - 15 Oct. 1971
Carl W. Helstrom Oct. 1971 50 p refs
(Grant NGL-05-009-079)
(NASA-CR-122307) Avail: NTIS CSCL 20F

The restoration of images focused on a photosensitive surface is treated from the standpoint of maximum likelihood estimation, taking into account the Poisson distributions of the observed data, which are the numbers of photoelectrons from various elements of the surface. A detector of an image focused on such a surface utilizes a certain linear combination of those numbers as the optimum detection statistic. Methods for calculating the false alarm and detection probabilities are proposed. It is shown that measuring noncommuting observables in an ideal quantum receiver cannot yield a lower Bayes cost than that attainable by a system measuring only commuting observables. Author

N72-12659# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.
ELECTROMAGNETIC GENERATION AND DETECTION OF ACOUSTIC WAVES
B. W. Maxfield Jun. 1971 77 p refs
(Contract AT(30-1)-2150)
(NYO-2150-73; Rept-1573) Avail: NTIS

Methods for generating acoustic waves in conducting materials are described which involve direct coupling of the eddy current electric field to the ions. Processes in the electromagnetic generation (EG) of acoustic waves discussed include: (1) the effect of an eddy current electric field on the ions within the skin depth, (2) the effect of a steady magnetic field, (3) electromagnetic detection, (4) exact solution of the general free electron metal problem, and (5) some potential practical uses for EG. F.O.S.

N72-12660# Los Alamos Scientific Lab., N.Mex.
MEDIUM ENERGY PHYSICS PROGRAM Quarterly Status Report, period ending 30 Apr. 1971
May 1971 57 p refs
(Contract W-7405-eng-36)
(LA-4692) Avail: NTIS

Topics include accelerator structures, RF power systems, accelerator control and instrumentation, accelerator physics, the experimental area, scheduling and facility construction, and physics research. Publications and papers are listed, and a listing of research proposals is given. NSA

N72-12661# Bendix Corp., Southfield, Mich. Research Labs.
INVESTIGATION OF FLUIDIC HIGH INTENSITY Final Report, 26 Feb. 1968 - 24 Apr. 1970
Bernard R. Teitelbaum and Lael B. Taplin Wright-Patterson AFB, Ohio AFFDL May 1971 132 p refs
(Contract F33615-68-C-1406; AF Proj. 4437)
(AD-726094; BRL-5335; AFFDL-TR-70-98) Avail: NTIS CSCL 20/1

The report summarizes the results of an investigation of a fluidic high-intensity sound generator concept. The investigation concerned the evaluation of a new type of proportional fluidic amplifier geometry, the annular slot amplifier. This amplifier was found to have significantly higher pressure gain than the conventional planar jet proportional amplifier, 4 to 12.5 versus 3 to 5. An annular slot amplifier model was tested over a frequency range from 300 Hz to over 2000 Hz. Its control port impedance was studied particularly, and the impedance as well as the amplifier gain were found to vary with frequency. The frequency dependence is attributed to a distributed-parameter feedback phenomenon in the vent region. An experimental two-stage sound generator was designed, fabricated, and tested. The second stage is an annular slot amplifier with its critical areas scaled up ten times over those of the first stage. The first stage control flow source is an electro-dynamic driver of the kind used with conventional loudspeakers. The second stage power jet area is 5.78 square inches, and the supply pressure is 10 psig. The radiating horn is exponential with a cutoff frequency of 180 Hz and an exit diameter of 42 inches. Author (GRA)

N72-12662# Kalamazoo Coll., Mich. Dept. of Physics.
STUDIES OF N WAVES FROM WEAK SPARKS IN AIR Final Report
Wayne M. Wright Jun. 1971 65 p refs
(Contract Nonr-3932(00); NR Proj. 384-321)
(AD-725865) Avail: NTIS CSCL 20/1

The report summarizes work performed at Kalamazoo College during the period 1962-1970 on the study of acoustic transients in air. The major portion of this research was a many faceted study of the acoustic transients produced in air by weak sparks. The spark energies were in the range 0.0016 - 0.56 J, and the acoustic waveforms resembled N waves with durations of 10 - 40 microseconds and amplitudes of the order of 0.01 atmosphere. These waveforms were observed by means of wide-band condenser microphones. It was possible to reproduce a weak shock with a rise time as short as 1/2 microseconds. Topics investigated include the dependence of acoustic waveform upon propagation direction, spark length, and discharge energy; the distortion of the wave profile with propagation distance; and the diffraction and scattering of N waves from rectangular plates, circular discs, and cylindrical rods. Author (GRA)

N72-12663# Catholic Univ. of America, Washington, D.C. Inst. of Ocean Science and Engineering.
ACOUSTIC RADIATION FROM MULTIPLE SURFACES Final Report
Ronald New Jan. 1970 92 p refs
(Contract N00014-69-A-0432)
(AD-726209; Rept-71-8) Avail: NTIS CSCL 20/1

A significant part of the current research effort in Acoustic Radiation Theory is concerned with transducer arrays and the effects of the interaction therein. There exist two broad sub-classes of the total problem: (1) one or more vibrating elements on a single common surface (baffle) and (2) one or more vibrating elements on multiple surfaces. Problems within the 1st sub-class have been treated extensively. Few solutions exist for problems within the 2nd sub-class and those that do are very restricted. This exposition seeks to extend the list of analytic developments to include solutions to certain multiple surface problems. Initially, the author obtains a formal solution to the problem of two vibrating spheres using the method of Green's functions. The extension to N vibrating spheres, of arbitrary radii and location, follows and is obtained directly from the two-sphere problem. It is shown that the method is generally applicable to the N-body problem if the individual body shapes conform to a 'separable' coordinate system and the total field can be made to satisfy the Sommerfeld radiation condition. Author (GRA)

N72-12664# Michigan Univ., Ann Arbor. Inst. of Science and Technology.
PROCEEDINGS OF THE SPECIAL MEETING ON UNCONVENTIONAL INFRARED DETECTORS
John E. Ivory Apr. 1971 168 p refs Conf. held at San Diego, Calif., 16 Mar. 1971; sponsored by ONR
(AD-726224; Rept-7142-54-X) Avail: NTIS CSCL 17/5

Contents: Effects of infrared radiation of gaseous plasmas; A review of the unusual optical properties of liquid crystals; A water-cooled cholesteric liquid crystal infrared imaging devices; The Josephson effect far-infrared detector; The superinductor as an infrared sensor, D. G. Naugle and W. A. Porter; Point contact diode detectors; Pyroelectric detection of infrared radiation; Pyromagnetic detectors; The Nernst detector; Photoconductivity in amorphous Ge-Pb-Sn-Te ALLOYS; Photoconductivity in amorphous germanium and silicon films; Chalcogenide glass bolometers; Heterodyne detection at 10.6 micrometers with thin film thermal detectors. GRA

N72-12665# ARO, Inc., Arnold Air Force Station, Tenn.
A COMPARISON OF VARIOUS COHERENT OPTICAL FILTERING OPERATIONS Final Report
Robert Lee Cody AEDC Jun. 1971 96 p refs
(Contract F40600-71-C-0002; ARO Proj. BC5116)
(AD-726091; ARO-OMD-TR-71-93; AEDC-TR-71-137) Avail: NTIS CSCL 20/6

A comparison is made of different coherent optical filters with respect to their ability to locate an edge and identify phase information. These different filtering methods are bandpass filtering, the Schlieren method, the Hilbert transform method, a linear amplitude filter, and a differential filter; these filters are one-dimensional. The differential filter is a combination of two filters, a linear amplitude filter and a Hilbert transform filter. A linear amplitude filter is made photographically by a programmed exposure of film to give the correct density variations. A Hilbert transform filter is a phase filter which is accomplished with a dielectric coating on glass. Bandpass filtering is accomplished by using a wire. With the use of a razor blade, the Schlieren method is achieved. The comparison of these filters indicated that bandpass filtering is superior for the location of an edge and that the Hilbert transform method is best for identifying phase information. Author (GRA)

N72-12666# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
LOW-LIGHT-LEVEL PERFORMANCE OF VISUAL SYSTEMS
Alvin D. Schnitzler Mar. 1971 99 p refs
(Contract DAHC15-67-C-0011; ARPA Proj. T-36)
(AD-725831; P-743; IDA/HQ-71-12373) Avail: NTIS CSCL 17/8

Visual systems for employment at low light levels are examined from two points of view: as extensions of the human visual system and as optical information acquisition and conversion systems. The first point of view is adopted to examine the general suitability and the limitations of reliance on the dark-adapted human eye alone, the dark-adapted human eye aided by binoculars, and the light-adapted human eye aided by photoelectronic imaging systems such as image intensifiers and low-light-level television. The second point of view is adopted to analyze the dependence of photoelectronic imaging system performance on system parameters. Author (GRA)

N72-12667# Naval Postgraduate School, Monterey, Calif.
FOURIER ANALYSIS OF EXPERIMENTAL FINITE AMPLITUDE STANDING WAVES M.S. Thesis
James R. Winn Jun. 1971 53 p refs
(AD-728568) Avail: NTIS CSCL 20/1

Finite-amplitude standing waves in air at ambient conditions contained in a rigid-walled cylindrical tube with a large length-to-diameter ratio were experimentally investigated. The pressure waveform at the end of the tube was digitized and Fourier analyzed on an IBM 360 digital computer. Amplitudes and phases were obtained for all harmonics with amplitudes greater than 1% of the fundamental for strength parameters from 0.25 to 1.00 and for frequency parameters from -0.8 to 2.0 The strength and frequency parameters are defined as MbΩ and 2 delta f/delta f respectively, where M is the Mach number of fundamental, b the nonliniarity parameter, Q the quality factor of the resonator, delta f the frequency away from fundamental resonance, and delta f the band width at the half-power points. These results are compared to the theoretical model of Coppens and Sanders. Author (GRA)

N72-12668# Maryland Univ., College Park. Dept. of Electrical Engineering.
THE STUDY OF THE INTERACTION OF INTENSE PICOSECOND LIGHT PULSE WITH MATERIALS Quarterly Technical Report, 19 Jun. - 18 Sep. 1970
Chi H. Lee 15 Oct. 1970 18 p refs
(Grant DA-ARO(D)31-124-70-G50; ARPA Order 675-7)
(AD-728175) Avail: NTIS CSCL 20/12

The report covers work under contract for the period June 19 to Sept. 18, 1970. Topics discussed include photoconductivity effect in GaAs induced by picosecond light pulses from a mode-locked Nd: glass laser. In addition to the two-photon absorption, the observed effect also involved stimulated hole scattering and three-photon absorption. Author (GRA)

N72-12669# Naval Research Lab., Washington, D.C.
ACOUSTIC RADIATION IMPEDANCE OF CAPS AND RINGS ON OBLATE SPHEROIDAL BAFFLES Interim Report
R. V. Baier 16 Jul. 1971 45 p refs
(NRL Proj. S01-29; RR Proj. 102-08-41-5226)
(AD-728382; NRL-7207) Avail: NTIS CSCL 20/1

The acoustic radiation impedance seen by curved vibrating caps and rings located on hard baffles of oblate spheroidal shape has been analyzed using eigenfunction expansion in oblate spheroidal wave functions. With the help of extensive computer programs the formulas have been numerically evaluated. The results are presented in families of plotted curves showing the effect of curvature on the acoustic radiation impedance. Calculations were made for ranges in acoustic size of 0.1 less than or equal to 20. Author (GRA)

N72-12670# Massachusetts Inst. of Tech., Cambridge. Francis Bitter National Magnet Lab.
PHYSICAL PHENOMENA AND PROPERTIES OF MATTER IN INTENSE MAGNETIC FIELDS Final Report
Benjamin Lax 30 Jul. 1971 81 p refs
(Contract F44620-67-C-0047; AF Proj. 9764-01)
(AD-728275; AFOSR-71-2040TR; Task-61102f; Task-681306)
Avail: NTIS CSCL 20/12

The Francis Bitter National Magnet Laboratory has carried on a program of basic and applied research using intense magnetic fields. Research results have been obtained in basic studies of magnetism, superconductivity and the optical properties of metals, semiconductors and semimetals. Improved techniques for the generation and measurement of intense magnetic fields and for the measurement of the effects of these fields on matter were developed. Author (GRA)

N72-11876# London Univ. (England).
SOUND FIELDS GENERATED BY TRANSONIC FLOWS OVER SURFACES HAVING CIRCULAR PERFORATIONS
M. M. Freestone and R. N. Cox *In* AGARD Facilities and Tech. for Aerodyn. Testing at Transonic Speeds and High Reynolds Number Aug. 1971 8 p refs (See N72-11854 03-01)
Avail: NTIS HC $6.00/MF $0.95

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N72-12671# Hamburg Univ. (West Germany).
CONTRIBUTION TO THE FOUNDATION OF THE PERTURBATION CALCULATION IN QUANTUM FIELD THEORY PROJECTED BY AN EXAMPLE OF A SCALAR AND NEUTRAL FIELD WITH CUBIC SELF-EXCHANGE EFFECT Ph.D. Thesis [BEITRAEGE ZUR BEGRUENDUNG DER STOERUNGSRECHNUNG IN DER QUANTENFELD-THEORIE, DARGE-STELLT AM BEISPIEL EINES SKALAREN UND NEUTRALEN FELDES MIT KUBISCHER SELBSTWECHSELWIRKUNG]
Manfred Buth 1970 50 p refs In GERMAN
Avail: NTIS

Perturbation calculations for quantum field theory are

developed by using the field operator of a model with known Lagrangian density to formulate a Heisenberg presentation. Reduction of the field equation to a system of integral equations and further to a recursive formulation gives a stepwise re-normalization during calculations of successive solutions.
Transl. by G.G.

N72-12672# Hamburg Univ. (West Germany).
OBSERVABLES AND GAUGE TRANSFORMATIONS IN THE PARAFIELD MODEL Ph.D. Thesis [OBSERVABLEN UND EICHTRANSFORMATIONEN IM PARAFELD MODEL]
Kai Druehl 1970 44 p refs In GERMAN
Avail: NTIS

The parafield model of Green encompasses tri-linear exchange that allow for the common Bose- or Fermi-relations in special cases. Green's theorem permits the construction of a class of these parafields containing particles which neither obey the Bose- nor the Fermi-statistics depending on the chosen observables algebra and the postulated locality. Imbedding of the observable algebras into a known field algebra with exchange relations results in their definition as invariants of certain symmetry groups.
Transl. by G.G.

N72-12673# Technische Hochschule Munchen (West Germany).
STUDY ON THE NUCLEAR LEVEL SCHEME OF GADOLINIUM THROUGH THE (NEUTRON, GAMMA) REACTION Ph.D. Thesis [UNTERSCHUNG DES KERNNIVEAUSCHEMAS VON Gd 158 MITTELS DER (NEUTRON, GAMMA) REAKTION]
Helmut Adolf Baader 1970 136 p refs In GERMAN
Avail: NTIS

Gamma spectrum measurements in Gd 157 after thermal neutron capture are used to study the Gd 158 energy level scheme. The ground level rotation band is discussed up to I=8(+), the gamma vibration band up to I=6(+), the beta vibration band and a K=0(+) band up to the spin 4(+) level. Also described is the K=1(-) octapol vibration band and the newly discovered octapol vibration bands with K=1(-) and K=2(-) up to I=6(-), I=5(-) and I=4(-). Level mixing calculations provide a good explanation for the relatively strong effects of couplings between bands.
Transl. by G.G.

N72-12674# Institute for Nuclear Physics Research, Amsterdam (Netherlands).
[NUCLEAR PHYSICS, SPECTROSCOPY, AND CHEMISTRY] Progress Report, 1970-1971
1971 101 p refs
Avail: NTIS

Progress is reported for research in nuclear physics with fast electrons, beta and gamma ray spectroscopy, beam spectroscopy, and nuclear and radiochemistry. Data covering instrumentation and facility operations are included.
E.H.W.

N72-12675*# Scientific Translation Service, Santa Barbara, Calif.
CONTRIBUTION OF THE EXCHANGE MECHANISM TO THE BACKWARD SCATTERING OF PROTONS BY LIGHT NUCLEI AND THE d PLUS He-4 YIELDS He-3 PLUS H-3 REACTION
B. Z. Kopeliovich and I. K. Potashnikova Washington NASA Nov. 1971 13 p refs Transl. into ENGLISH from Russian report P2-5496
(Contract NASw-2035)
(NASA-TT-F-14051; P2-5496) Avail: NTIS CSCL 20H

The role of the exchange mechanism in backward scattering of protons by He-3 and He-4 nuclei is discussed. The simplest exchange diagram for backward scattering of protons by He-4 is calculated by means of the wave function, the parameters of which were fixed by data concerning the scattering of electrons. A good agreement with the experimental data was attained. In the energy dependence of the backward-scattering cross section of protons with He-4 nuclei, a characteristic dip in the region of 200 MeV is anticipated. An evaluation was performed of the parameters which determine the behavior of the wave function of He-3 at short distances. The d + He-4 yields He-3 + H-3 reaction was examined. Experiments were proposed for clarifying the mechanism responsible for the processes examined.
Author

N72-12676*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BACKWARD ELASTIC pd SCATTERING AT 316, 364, 470 AND 590 MeV
J. C. Alder (Coll. of William and Mary), W. Dollhopf (Coll. of William and Mary), C. Lunke (Coll. of William and Mary), C. F. Perdrisat (Coll. of William and Mary), W. K. Roberts, P. Kitching (Alberta Univ.), G. F. Moss (Alberta Univ.), W. C. Olsen (Alberta Univ.), and J. R. Priest (Miami Univ., Oxford, Ohio) 1971 17 p refs Presented at the Southwest Sect. Meeting of the Am. Phys. Soc., Columbia, South Carolina, 4-6 Nov. 1971
(NASA-TM-X-67943; E-6618) Avail: NTIS CSCL 20H

Preliminary results are reported from a part of the data obtained at the NASA Space Radiation Effect Laboratory for the elastic scattering of protons by deuterons in the backward hemisphere. The data is averaged over a proton angle interval which corresponds to the angular resolution on the correlation angle, given the proton bin used in the data analysis.
Author

N72-12677*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HAMILTONIAN FORMULATION OF GUIDING CENTER MOTION
David P. Stern Sep. 1971 42 p refs Supersedes X-641-71-56; N71-19205
(NASA-TM-X-65700; X-641-71-373; NASA-TM-X-65458; X-641-71-56) Avail: NTIS CSCL 20H

The nonrelativistic guiding center motion of a charged particle in a static magnetic field is derived using the Hamiltonian formalism. By repeated application of first-order canonical perturbation theory, the first two adiabatic invariants and their averaged Hamiltonians are obtained, including the first-order correction terms. Other features of guiding center theory are also given, including lowest order drifts and the flux invariant.
Author

N72-12678# Academy of Sciences (USSR), Moscow.
QUANTUM MECHANICS AS RELATIVISTIC STATISTICS: THE TWO-PARTICLE CASE
Yu. A. Rylov 1971 30 p refs In RUSSIAN
(PR-74) Avail: NTIS

It is shown that nonrelativistic quantum mechanics can be treated as a kind of relativistic statistical theory, which describes indeterministic motion of classical particles. The theory is relativistic in the sense that the relativistic motion of particle state is used and the equations of motion are used two times. The principles and relations of quantum mechanics are derived from the principles of statistics and classical mechanics.
Author

N72-12679# Joint Publications Research Service, Washington, D.C.
THE EFFECTIVE CROSS SECTION OF STIMULATED EMISSION IN INHOMOGENEOUSLY BROADENED ACTIVE MEDIA
V. V. Grigoryants, M. L. Gurari, and M. Ye. Zhabotinskiy 10 Nov. 1971 6 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii (Moscow), v. 14, no. 1, 1971 p 154-157
(JPRS-54440; UDC-535.35; CSO-0291/72-W) Avail: NTIS

The cross section of stimulated emission was studied as an important characteristic of active laser materials, since amplification in the media is defined by it. An estimate of the influence of the intensity and width of the test signal spectrum on the value for the measured cross section of stimulated emission is made by using a kinetic equation for the spectral population density of the metastable level. By integrating the equation with respect to frequency, and applying the mean-value

theorem, the quantity which determines the actual amplification in the medium is derived. F.O.S.

N72-12680# Grumman Aerospace Corp., Bethpage, N.Y. Aerophysics Section.
ENERGY SPECTRA OF ELECTRONS FROM IN-FLIGHT DECAY OF VARIOUS MESONS AND BARYONS
Paul K. Suh Oct. 1971 54 p refs
(RE-416) Avail: NTIS

The pion-muon-electron and kaon-muon-electron decay processes are analyzed to yield analytical energy spectra of electrons produced in free space. Various simple but useful approximations that closely reproduce correct calculations are also discussed. These results are then further applied to determine the energy spectra of electrons produced from other kaon decay modes and baryon decays. Author

N72-12681# Joint Publications Research Service, Washington, D.C.
A DETERMINATION OF THE RELAXATION TIME t SUB 21 OF THE 4I11/2 LEVEL OF NEODYMIUM IONS IN GLASS
V. V. Grigoryants, M. Ye. Zhabotinskiy, and V. M. Markushev 10 Nov. 1971 7 p refs Transl. into ENGLISH from Zh. Prikl. Spektrosk. (Minsk), v. 14, no. 1, 1971
(JPRS-54439; UDC-621.375.3) Avail: NTIS

An experimental determination of the value of the relaxation time of the 4I11/2 level of Nd(+3) ions is presented for homogeneous broadening of the luminescence line. A system of equations describing the behavior of the populations of the upper and lower laser levels in the generation process in given, assuming a uniform broadening of the spectral line. It can be shown that for times of excitation transfer between centers much greater than pulse duration, the cross section of stimulated emission is a smoothly decreasing function of the total photon flux Q, approaching zero as a limit as Q approaches infinity. A system of equations is described for the spectral population densities of inhomogeneously broadening levels, assuming pulse duration is small with respect to times of excitation transfer between centers, pumping time, and decay time of the upper laser level. Relaxation time was measured for Nd ions in phosphate glass in which distortion of the spectral line due to pulse duration was not detected. Author

N72-12682*# ART Research Corp., Los Angeles, Calif.
FASTER 3: A GENERALIZED-GEOMETRY MONTE CARLO COMPUTER PROGRAM FOR THE TRANSPORT OF NEUTRONS AND GAMMA RAYS. VOLUME 1: SUMMARY REPORT
Thomas M. Jordan 15 Dec. 1970 51 p refs 2 Vol.
(Contract NAS3-14400)
(NASA-CR-124636; ART-45-Vol-1) Avail: NTIS CSCL 20H

The theory used in FASTER-III, a Monte Carlo computer program for the transport of neutrons and gamma rays in complex geometries, is outlined. The program includes the treatment of geometric regions bounded by quadratic and quadric surfaces with multiple radiation sources which have specified space, angle, and energy dependence. The program calculates, using importance sampling, the resulting number and energy fluxes at specified point, surface, and volume detectors. It can also calculate minimum weight shield configuration meeting a specified dose rate constraint. Results are presented for sample problems involving primary neutron, and primary and secondary photon, transport in a spherical reactor shield configuration. Author

N72-12683*# ART Research Corp., Los Angeles, Calif.
FASTER 3: A GENERALIZED-GEOMETRY MONTE CARLO COMPUTER PROGRAM FOR THE TRANSPORT OF NEUTRONS AND GAMMA RAYS. VOLUME 2: USERS MANUAL
Thomas M. Jordan 16 Nov. 1970 200 p 2 Vol.
(Contract NAS3-14400)
(NASA-CR-124637; ART-45-Vol-2) Avail: NTIS CSCL 20H

A description of the FASTER-III program for Monte Carlo Carlo calculation of photon and neutron transport in complex geometries is presented. Major revisions include the capability of calculating minimum weight shield configurations for primary and secondary radiation and optimal importance sampling parameters. The program description includes a users manual describing the preparation of input data cards, the printout from a sample problem including the data card images, definitions of Fortran variables, the program logic, and the control cards required to run on the IBM 7094, IBM 360, UNIVAC 1108 and CDC 6600 computers. Author

N72-12684*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ATOMIC EMISSION LINE WAVELENGTH CALCULATIONS BELOW 2000 ANGSTROMS FOR LITHIUM II THROUGH COBALT XXVI
Michael D. Williams Washington 1971 118 p refs
(NASA-SP-3068) Avail: NTIS CSCL 20H

Atomic-emission-line wavelengths are presented which were calculated from wavelengths of previously identified transition sequences using second-degree polynomials fitted to known wave numbers by the least squares method. Wavelengths less than 2000 angstroms are included for ions from Li II to Co XXVI. The computer program written in FORTRAN 4 is also included. F.O.S.

N72-12685# Stanford Univ., Calif. Dept. of Physics.
NUCLEAR STRUCTURE INVESTIGATIONS WITH AN FN TANDEM ACCELERATOR Progress report, 1 Mar. 1970 - 28 Feb. 1971
Stanley S. Hanna and Walter E. Meyerhof 15 Sep. 1971 187 p refs
(Grant NSF GP-8163-s3)
Avail: NTIS

An active research program on the Tandem Van de Graaff accelerator is described. Low mass nuclei were studied by a variety of reactions and new levels were found whose properties could be compared with nuclear model calculations. Studies of the giant resonance continued and it was shown that the isospin splitting of the resonance, probably also exists in lighter nuclei. The gamma and particle decays of several high-isospin states in the lighter nuclei was investigated. Analog states in several nuclei with A approximately 90 were located using elastic and inelastic scattering cross sections. A theory was developed which reproduces consistently the shapes of the cross sections, including the location of resonances. Gamma and particle emission in several heavy ion reactions was studied. Author

N72-12686# Rochester Univ., N.Y. Nuclear Structure Research Lab.
MULTIPOLE SUM RULES AND Cu-63 IN THE PARTICLE-CORE COUPLING MODEL. GAMMA DECAYS IN Cu-63
Roger Markham and H. W. Fulbright Oct. 1971 55 p refs Supported in part by NSF
(UR-NSRL-41) Avail: NTIS

The origin and nature of various multipole sum rules in the context of the intermediate coupling approach of the unified model are discussed. Useful sum rules are written out in detailed form, and an approximate two neutron transfer sum rule is proposed. Intermediate coupling for Cu-63 is calculated. Comparisons with experiments are made for energy levels, proton stripping strengths, and electromagnetic transition strengths. Realistic core matrix elements are used for the particle-core interaction. An upper limit of 2.0 is set for the effective proton charge and use of a bare proton charge of 1.0 is reasonable. Branching ratios were found for gamma ray transitions between the low-lying states of Cu-63 by examining the radiation following the decay of Zn-63 to Cu-63. Reduced M1 transition probabilities are compared with predictions of the intermediate coupling model. Evidence is found that 1(+) core

excitations play an important role in determining M1 transition probabilities. Effective M1 single-particle matrix elements are derived. Author

N72-12687*# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.
NUCLEAR ELECTROMAGNETIC CASCADES FROM NUCLEI WITH Z LARGER THAN OR EQUAL TO 3
W. V. Jones [1971] 6 p refs Sponsored in part by NSF Prepared in cooperation with Max-Planck Inst. fuer Phys. and Astrophys.
(Contract NAS9-10986; Grant NGR-19-001-012)
(NASA-CR-124581; OG-57) Avail: NTIS CSCL 20H

A Monte Carlo simulation method was developed for studying nuclear-electromagnetic cascades initiated by high energy nuclei with Z > or = 3 incident on heavy absorbers. The calculations are based on a cascade model which was first adjusted until it agreed with measurements made with protons at an accelerator. Modifications of the model used for protons include the incorporation of the probabilities for fragmentation of heavy nuclei into lighter nuclei, alpha particles, and nucleons. Mean values and fluctuations of the equivalent numbers of particles in the cascades at various depths in an iron absorber are presented for protons, carbon, and iron nuclei over the 30 to 300 GeV/nucleon energy range. Author

N72-12688# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany). Nuclear Chemistry Div.
RADIONUCLIDE AND REACTOR CHEMISTRY RESEARCH Annual Research Report, 1970
Apr. 1971 30 p refs
(HMI-B-107) Avail: AEC Depository Libraries

Abstracts of all papers published and accepted for publication from January 1970 to April 1971 and of two doctoral theses and a cumulative list of publications from 1968 to April 1971 are presented. NSA

N72-12689# Institute of Nuclear Research, Warsaw (Poland).
STUDIES OF EPITHERMAL CELL PARAMETERS IN THE REACTOR LATTICES WITH MULTITUBE ENRICHED FUEL
E. T. Jozefowicz 1971 22 p refs
(INR-P-1266) Avail: AEC Depository Libraries

Methods of measuring epithermal cell parameters, epithermal-to-thermal fission ratio, and resonance-to-thermal absorption ratio in U-238 are described. The interpretation of the experimental results in the framework of an infinite multiplication factor is given, and simple methods of calculating resonance escape probabilities in U-235 and U-238 are presented. Collision probability considerations were taken into account in cells with complicated structure. Results are given for a few types of lattices: water moderated (WWR-SM normal and diluted), graphite and water moderated (ANNA with water), graphite moderated (ANNA without water), and beryllium and water moderated (MR-type). Author (NSA)

N72-12690# Rensselaer Polytechnic Inst., Troy, N.Y.
LINEAR ACCELERATOR PROJECT Progress Report, 1 Oct. - 31 Dec. 1970
31 Dec. 1970 47 p refs Submitted for publication
(Contract AT(30-1)-328)
(RPI-328-209) Avail: NTIS

The work included neutron cross section measurements and experimental and theoretical reactor physics and engineering. NSA

N72-12691# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimentalnoi Fiziki.
STUDY OF THE FLUCTUATIONS OF THE DIMENSIONS OF A BEAM IN CIRCULAR ACCELERATORS WHEN CALCULATING THE FORCES OF THE SPACE CHARGE
P. R. Zenkevich 1970 16 p refs In RUSSIAN, ENGLISH summaries
(ITEF-813) Avail: AEC Depository Libraries

Free and forced oscillations of the beam cross section in circular accelerators are investigated taking space charge forces and betatron frequency spread into account. Author (NSA)

N72-12692# Washington Univ., St. Louis, Mo.
SUMMARY REPORT ON CYCLOTRON UTILIZATION, OPERATIONAL ACHIEVEMENTS, AND IMPROVEMENTS Technical Progress Report, 1 Jun. 1970 - 31 May 1971
15 Jul. 1971 24 p
(Contract AT(11-1)-1760)
(COO-1760-4) Avail: NTIS

The development and operation of the cyclotron are summarized. Accelerator operation time and utilization and beam parameters are tabulated; and peripheral developments and improvements are outlined. NSA

N72-12693# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
NANOSECOND PULSED BEAM EXPERIMENTS AT THE HEAVY ION CYCLOTRON
U. Hagemann, W. Neubert, W. Schulze, and F. Stary 1971 15 p refs Submitted for publication
(JINR-E13-5796) Avail: AEC Depository Libraries

The experimental arrangement was installed at the 3 m heavy ion cyclotron in Dubna for performing spectroscopic in-beam measurements. By making use of the natural beam bunching, isomeric states with lifetimes down to 10 ns can be measured. The gamma radiation is detected by a planar Ge(Li) detector. Author (NSA)

N72-12694# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Energii.
CHARACTERISTICS OF THE ACCELERATED PROTON BEAM AT THE 70 GeV ACCELERATOR
V. I. Gridasov, B. A. Zelenov, V. A. Zenin, and K. P. Myznikov 1970 12 p refs In RUSSIAN
(IFVE-SKU-70-58) Avail: AEC Depository Libraries

Dependences of the amplitudes of radial-phase oscillations and the dimensions of an accelerated beam on its energy are defined. Distribution functions in the amplitudes of the radial and vertical betatron oscillations were found. This information on the beam is necessary to solve the problems connected with the particle ejections from the accelerator. Author (NSA)

N72-12695# Atomic Energy Commission, New York.
USSR REPORTS ON FALLOUT AND ON NATURAL RADON
1 Jun. 1971 161 p refs
(AEC-TR-7232) Avail: NTIS

Abstracts are presented for papers on the effects of radioactive fallout on human beings and other organisms. The distributions of Sr-90, Cs-137, and short-lived daughter products of natural radon are discussed. K.P.D.

N72-12696# Los Alamos Scientific Lab., N.Mex.
TABLES OF COEFFICIENTS FOR ANALYSIS OF ANGULAR DISTRIBUTION OF GAMMA RADIATION FROM ORIENTED NUCLEI
K. S. Krane Jun. 1971 49 p refs
(Contract W-7405-eng-36)
(LA-4677) Avail: NTIS

Values of the orientation parameters (evaluated for magnetic dipole interactions), deorientation coefficients, and angular distribution coefficients are tabulated for transitions of multipolarity up to octupole and for nuclear levels of integral and half-integral spins up to eight. A brief table of Legendre polynomials is also provided. The matrix elements employed in defining the gamma ray multipole-mixing ratios are defined explicity. Author (NSA)

N72-12697# Rutherford High Energy Lab., Chilton (England).
DISTRIBUTION OF DOSE AND INDUCED ACTIVITY AROUND EXTERNAL PROTON BEAM TARGETS
G. S. Levine, Dorothea M. Squier, G. B. Stapleton, G. R. Stevenson, K. Goebel, and J. Ranft [1971] 18 p refs Presented at the Intern. Congr. on Protection Against Accelerator and Space Radiation, Geneva, 26-30 Apr. 1971
(RPP/R-9; CONF-710423-4) Avail: AEC Depository Libraries

Measurements of the flux density of hadrons and the energy deposition by the hadron and electromagnetic cascades around targets in external proton beams are described. These measurements are compared with predictions of Monte Carlo calculations. How these calculations and measurements can be used to predict the dose to personnel in an accident situation or the dose which can cause radiation damage and the gamma dose rates from radioactivity induced in components of present and future high energy accelerators are indicated. Author (NSA)

N72-12698# California Univ., Riverside. Dept. of Physics.
ARE THERE TWO A2 MESONS?
R. T. Poe and B. C. Shen 1970 13 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev, 26 Aug. 1970
(Contract AT(04-3)-34)
(UCR-34-P-107-B-112; Conf-700806-61) Avail: NTIS

A model for the A2 phenomenon is described. The A2 splitting and other seemingly conflicting data can be understood within the framework of this model which assumes different mass shifts in the A2 production amplitude from rho meson and f(0) exchanges. Author (NSA)

N72-12699# McDonnell-Douglas Astronautics Co., Richland, Wash. Donald W. Douglas Labs.
PLUTONIA/CURIA COMPATIBILITY TESTING Quarterly Report, Jan. - Mar. 1971
R. L. Andelin and J. D. Watrous Apr. 1971 24 p
(Contract AT(45-1)-2138)
(MDC-G-2055; QR-10; UC-33; R0032) Avail: NTIS

Exposure of plutonia-molybdenum cermets at 1800 and 2000 C for 5000 and 10,000 hours resulted in essentially 100% helium release and major deterioration in the structure. Preliminary metallographic results of curia/refractory alloy combinations exposed at 2000 C for 1000 hours show intergranular attack of tungsten, solution attack of molybdenum, and only minor superficial attack of molybdenum-46% rhenium and tungsten-25% rhenium. Exposure tests continue at 1800 C on plutonia/refractory metal and at 1800 and 2000 C on curia/refractory metal combinations. A series of 20 systems-oriented specimens of various plutonia-molybdenum cermet or plutonia-thoria-molybdenum cermet/refractory alloy combinations is currently being exposed at 1500, 1800, and 2000 C.
Author (NSA)

N72-12700# Oak Ridge National Lab., Tenn.
THERMONUCLEAR DIVISION Annual Progress Report, period ending 31 Dec. 1970
Aug. 1971 142 p refs
(Contract W-7405-eng-26)
(ORNL-4688; Dr-1876; UC-20) Avail: NTIS

Abstracts are presented for discussions of phases of reactor technology and plasma physics. Topics considered are atomic and molecular cross sections for inelastic scattering, mirror confinement, high beta plasmas, turbulent heating, energetic particle injection, plasma theory, reactor design and construction, and superconductivity. K.P.D.

N72-12701# Ohio State Univ. Research Foundation, Columbus.
HIGH ENERGY PHYSICS STUDIES, PART 1 AND 2
1 Jul. 1971 34 p refs
(Contract AT(11-1)-1545)
(COO-1545-99-Pt-1-2) Avail: NTIS

A summary of experimental research on leptonic decays of hyperons and neutron-proton charge exchange, and theoretical research on symmetry and dynamical calculations is presented. A list of publications is included. NSA

N72-12702# California Inst. of Tech., Pasadena.
QUANTUM NUMBERS OF CROSS CHANNEL EXCHANGES
J. Mandula, J. Weyers, G. Zweig, and F. Halzen (European Organ. for Nucl. Res.) 1971 11 p refs Presented at the Workshop on Particle Phys. at Intermediate Energies, Pasadena, Calif., 29-30 Mar. 1971
(Contract AT(11-1)-68)
(CALT-68-305; Conf-710316-2) Avail: NTIS

A study of the quantum numbers of crossed-channel exchanges is made for high-energy interactions. All relations following from the absence of exotic exchanges which have the property that their violation is proportional to the interference between an exotic and a nonexotic exchange rather than to the square of an exotic exchange are cataloged. NSA

N72-12703# Washington Univ., Seattle. Dept. of Physics.
COMMENTS ON A DUAL MULTIPARTICLE THEORY WITH NONLINEAR TRAJECTORIES
M. Baker and D. D. Coon [1971] 10 p refs
(Contracts AT(45-1)-1388; AT(11-1)-1764)
(COO-1764-120) Avail: NTIS

Some features of the nonlinear trajectories of a dual multiparticle theory are examined and the development of the theory is discussed. Author (NSA)

N72-12704# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE NUMBER OF RESONANCES OF NONLOCAL SEPARABLE POTENTIALS
P. Beregi 1971 18 p refs
(JINR-E4-5837) Avail: AEC Depository Libraries

The possibility of including resonances into quantum mechanical two-body systems with the help of nonlocal separable potentials is investigated. It is shown that the number of the resonances, in contrast to the number of the bound states, is not limited by the number of attractive terms contained in the nonlocal separable potentials, but it depends on the form factors.
Author (NSA)

N72-12705# Institute of Nuclear Research, Warsaw (Poland).
POSSIBILITY OF EXISTENCE OF A NEW PROCESS AT INTERACTIONS WITH ENERGIES ABOVE 10 TO THE 12TH POWER eV
J. Gawin, R. Maze, and J. Wdowczyk 1971 15 p refs
(INR-1280) Avail: AEC Depository Libraries

Investigation of cosmic rays during the last decade yielded the discovery of phenomena which are difficult to explain within the generally accepted model of high energy interactions. Among these phenomena are so-called X-process, horizontal showers, and muon-poor showers. It is shown that these three strange phenomena can be explained simultaneously if the existence of an interaction process occurring at energies above 10 to the 12th power eV is assumed. One feature of the process is the production of a massive particle with a relatively long life and minor activity. The cross section of the process should be approximately two to three orders of magnitude smaller than that of nuclear interactions. Author (NSA)

N72-12706# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
APPLICATION OF THE PADE APPROXIMATION TO THE PROBLEM FOR BOUND STATES IN QUASIPOTENTIAL APPROACH
A. Atanasov 1971 13 p refs In RUSSIAN
(JINR-P2-5765) Avail: AEC Depository Libraries

In the quasipotential approach, the bound-state energy of the two spinless-particle system is determined by approximate method. It is shown that definition of the Pade-fraction poles is

reduced to determination of the eigenvalues of corresponding homogeneous equation by the nucleus traces. Author (NSA)

N72-12707# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
FUNDAMENTAL PROBLEMS OF THE ELEMENTARY PARTICLE THEORY
1970 140 p refs Presented at the 15th Intern. Rochester on High Energy Phys. Kiev, 29 Aug. 1970
(ITF-70-99) Avail: AEC Depository Libraries

High energy scattering and dual resonance amplitudes, and models for them, are discussed. Quantum field theory and gravitation's role in elementary particle theory are also considered. K.P.D.

N72-12708# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
DUAL AMPLITUDE WITH MANDELSTAM ANALYTICITY
A. I. Bugrii, L. L. Enkovskii, and N. A. Kobylinskii 1971 9 p refs
(ITF-71-28-E) Avail: AEC Depository Libraries

A dual crossing symmetric amplitude satisfying a Mandelstam representation with correct spectral function boundaries, second sheet poles, and Regge asymptotic behaviour is suggested. The explicit form of the amplitude for elastic pion pion-scattering is given. Possible applications are indicated. Author (NSA)

N72-12709# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
MODEL OF THE MULTIPLE PARTICLE PRODUCTION
N. K. Dushutin and V. M. Maltsev 1971 17 p refs In RUSSIAN
(JINR-P2-5829) Avail: AEC Depository Libraries

In this model, as compared to statistical ones, the secondary particles do not reach the thermodynamical equilibrium during the collision time, and the whole interaction is considered to be a random process. Author (NSA)

N72-12710# Syracuse Univ., N.Y.
NOTE ON THE MOST PROBABLE NUMBER OF PARTONS IN PARTON MODELS
C. W. Gardiner (Waikato Univ., Hamilton, New Zealand) and D. P. Majumdar Feb. 1971 11 p refs Sponsored by AEC Submitted for publication
(SU-1206-246; NYO-3399-246) Avail: NTIS

From analysis of the inelastic e-p scattering data it is found that an important feature of the parton probability function P(N) is that it should be peaked around some small number of partons. The most probable number of partons is prognosticated to be around 4.5. Contrary to the usually accepted forms of P(N), where it decreases uniformly from a maximum, it is found that the data also allow a behavior of P(N) where it rises to a maximum first and then decreases with increase of N. Author (NSA)

N72-12711# Syracuse Univ., N.Y. Dept. of Physics
INELASTIC COMPTON SCATTERING INEQUALITIES IN QUARK-PARTON MODEL
D. N. Goswami and D. P. Majumdar Apr. 1971 16 p refs
(SU-1206-250) Avail: NTIS

On the assumption that partons are quarks, several constraint relations are derived for the structure functions of inelastic Compton scattering. Bounds on the structure functions of the inelastic Compton scattering with respect to those of inelastic electron-proton scattering are also discussed. All these inequalities are true for any quark-parton model and, thus, furnish some means of testing the hypothesis of individual quark-parton identification. These are also very useful for obtaining information about the parton distribution function P(N) and about the minimum number of partons in a nucleon. Assuming (1/N) = 0.1, which is consistent with the presently available data on both inelastic electron and inelastic neutrino scatterings, some quantitative analysis of the structure functions is made. Author (NSA)

N72-12712# California Univ., Berkeley. Lawrence Radiation Lab.
MONITORING OF POSITIVELY CHARGED PARTICLES IN THE ELECTRON RING ACCELERATOR
J. Goebel, J. B. McCaslin, H. W. Patterson, and A. R. Smith Apr. 1971 11 p refs
(Contract W-7405-eng-48)
(UCRL-20664) Avail: NTIS

Some methods for beam monitoring of protons and heavy ions at the ERA are discussed in terms of sensitivity and susceptibility to interference from competing reactions. Results presented of a pilot exposure at the 88-inch cyclotron compare calculated and measured production rates of Tb-149 and Tb-151 from bombardment of a cerium target with 55.48-MeV nitrogen ions. From this work it is concluded that at least 10 to the 11th power ions are needed to produce a measurable amount of alpha activity. Author (NSA)

N72-12713# European Organization for Nuclear Research, Geneva (Switzerland). Synchro-cyclotron Machine Div.
SYSTEMATICS OF EXTRA NUCLEAR HADRON CASCADES IN SHIELDS
M. Barbier and R. Hunter 21 Jun. 1971 35 p refs
(CERN-71-13) Avail: AEC Depository Libraries

An attempt is made to find a mathematical model for the buildup and decay of cascades produced in the shield by very high-energy incident particles. It is found that a first approximation can be given for the lateral spread of such cascades. Simplification of the model, numbers and energy spectra of the various generations of secondaries, the development of the hadron shower along an axis, the lateral spread of the cascade, the first generation, and muons are considered. NSA

N72-12714# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
SOURCES OF MULTICHARGED IONS. SUMMARY OF THE 14TH ALL-UNION CONFERENCE ON EMISSION ELECTRONICS, TASHKENT, MAY 1970
E. D. Vorobev and A. S. Pasyuk 1970 32 p refs In RUSSIAN
(JINR-P7-5177) Avail: AEC Depository Libraries

At the present time there are four known methods for obtaining multicharged ions: (1) in arc discharges at pressures approximately 0.001 torr; (2) with electron beams in high vacuum; (3) interaction of powerful laser beams with gases or solid surfaces; and (4) powerful spark discharges. With arc-type sources, heavy ions up to 12(+) charge state can be obtained. In the first experiments with electron radiation sources, gold ions were produced. Using lasers, optical spectra of ions up to 18(+) were observed. In condensation vacuum sparks, spectra of ions up to 20(+) were noted. Author (NSA)

N72-12715# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
ASYMPTOTIC FIELDS FOR THE APPROXIMATED, RENORMALIZED, TWO DIMENSIONAL YUKAWA MODEL AND :P(phi 2): MODEL
Ya. M. Yakymiv 1971 22 p refs In RUSSIAN
(ITF-71-12-P) Avail: AEC Depository Libraries

The renormalized Yukawa theory in space-time of two dimensions and the boson field phi(x) with interaction of the form :P(phi2(x)): are considered. Asymptotic limits of the annihilation-creation operators are proved to exist. It is also shown that the commutation relation between these asymptotic operators and the total Hamiltonian are of the same form as those between free operators and the free Hamiltonian. Author (NSA)

N72-12716# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Inst.
EFFECTS OF RADIOINDUCED DEFECTS ON CERTAIN MECHANICAL PROPERTIES OF MATERIALS
A. S. Kruglov and L. N. Ovander 1970 18 p refs In RUSSIAN
(FEI-192) Avail: AEC Depository Libraries

A study of the results of subjecting various materials to neutron irradiation shows three stages. First there is an incubation interval of dose where the yield point does not differ from its initial value. Then the yield point increases linearly as a function of neutron dose, and finally, the yield point changes less rapidly with increasing neutron dose. It is assumed that neutron collisions can yield depleted zones or radiation defects causing strengthening of the material. The interaction of these defects with each other gives a physical model that can be used to explain the above behavior of a neutron irradiated material. At first the concentration of defects is small and the defects do not interact with each other. This period is the incubation period. It is then shown that dislocations secured by the radiation defects lead to strengthening in irradiated materials. In addition to depleted Seeger zones it is necessary to postulate the formation of densified zones in order to explain the mechanical properties of materials at high irradiation doses. The elastic stresses caused by the densified zones hinder. NSA

N72-12717# Idaho Nuclear Corp., Idaho Falls.
AUTOMATED CROSS SECTION ANALYSIS PROGRAM (ACSAP)
N. H. Marshall, J. W. Codding, O. D. Simpson, and J. P. Smith 1971 7 p refs Presented at 3d Conf. on Neutron Cross Sect. and Technol., Knoxville, Tenn., 15 Mar. 1971 Sponsored by AEC
(Conf-710301-6) Avail: NTIS

The Automated Cross Section Analysis Program (ACSAP) is a FORTRAN computer program developed to speed the analysis of neutron cross section data. The program automatically adjusts single level or multilevel resonance parameters until the theoretical curve is in good agreement with a preselected set of experimental data points. The procedure is essentially an iterative method with ACSAP adjusting the resonance parameters for each iteration. Total, fission, capture, or scattering data may be fitted. Data from the final iteration (or even intermediate ones) may be printed or plotted at the user's discretion. ACSAP allows each user to program his problem, making the code very flexible and easy to use. This versatility makes ACSAP a powerful tool in cross section evaluations. Author (NSA)

N72-12718# Idaho Nuclear Corp., Idaho Falls.
EFFECT OF CROSS SECTION VARIATION ON INTEGRALS MEASURED IN THE CFRMF
J. J. Scoville 1971 8 p refs Presented at 3d Conf. on Neutron Cross Sect. and Technol., Knoxville, Tenn., 15 Mar. 1971 Sponsored by AEC
(Conf-710301-7) Avail: NTIS

Activation integral measurements of Au, (U-238)(n,gamma), and (U-235)(n,f) are described. The experimental results are compared to calculations employing ENDF/B-2 data and reveal inconsistencies beyond that expected from experimental error. These inconsistencies cannot be resolved by arbitrary adjustment of the cross section of any one of the materials. Various schemes of cross section variations and their effect on the integrals are presented. Energy dependent reaction rates were plotted for each of the three materials. These are discussed in terms of specific energy regions and their importance to the total integral. Author (NSA)

N72-12719# Osaka Univ. (Japan). Lab. of Nuclear Studies.
UNITARITY, FACTORIZATION THEOREM AND REMOVAL OF LEVEL DEGENERACY IN DUAL RESONANCE MODEL
Syozi Kawati, Gaku Konisi, Takesi Saito, and Azuma Tanaka Feb. 1971 9 p refs
(OU-LNS-71-1) Avail: AEC Depository Libraries

It is shown that by using a unitarity relation for many-body scattering amplitude, a Regge residue appearing in this amplitude is factorized. This theorem is a generalization of the two-body case. According to this theorem the level degeneracy in dual resonance models may be expected to be removed since unitarity is taken into account. An equation is proposed for removing the degeneracy, which has a strong resemblance to that in the quantum mechanical perturbation theory with degenerate levels. Author (NSA)

N72-12720# European Organization for Nuclear Research, Geneva (Switzerland).
FILTERING OF TRACKS MEASURED ON THE SMP
R. P. Kokoulin, V. P. Mikheev, and V. P. Protasov Mar. 1971 20 p refs Transl. into ENGLISH from Gos. Kom. po Ispolz. At. Energii SSSR, Moscow, Rept. no. ITEF-784
(CERN-Trans-71-8; ITEF-784) Avail: AEC Depository Libraries

A computer program for analysis of particle track photographs is described. The program discards background points and averages the remaining track points so that 5 to 20 mean points are obtained. Test runs resulted in errors of 14.2% from film with a 70% background and 1.8% from a film with a 40% background. The average processing time for one track is 1.5 sec on an M-20 machine. A block diagram of the program is included. NSA

N72-12721# Iowa State Univ. of Science and Technology, Ames.
X-RAY DIFFRACTION STUDY OF THE YTTRIA-HAFNIA SYSTEM Ph.D. Thesis
Denzil Wayne Stacy Jun. 1971 84 p refs
(Contract W-7405-eng-82)
(IS-T-425) Avail: NTIS

Phase equilibria in the yttria-hafnia system were investigated by high temperature X-ray diffraction and by room temperature X-ray diffraction after fixed temperature anneals. The monoclinic-to-tetragonal phase transformation in hafnia was found to occur over the temperature interval 1750 to 1850 C on heating. The reverse reaction occurred from 1800 to 1550 C on cooling. Under 2000 C, the solubility of yttria in hafnia is below 1 mole %. The fluorite domain extends from 7 to 53 mole % yttria at 1600 C and from 5 to 55 mole % yttria at 2000 C. A single phase domain of yttria solid solution exists above 73 mole % yttria at 1600 and 2000 C. The liquidus curve remains nearly at the melting point of hafnia (2825 C) up to 40 mole % yttria. Beyond, the liquidus decreases to a minimum of 2340 C at 85 mole % yttria and then increases to the melting point. The thermal expansion of yttria and several fluorite compositions was measured by high temperature X-ray. Author (NSA)

N72-12722# Osaka Univ. (Japan). Lab. of Nuclear Studies.
[NUCLEAR PHYSICS RESEARCH] Annual Report, Jan. - Dec. 1970
[1970] 49 p
(OU-LNS-71-2) Avail: AEC Depository Libraries

Progress and research topics of the cyclotron division, high voltage accelerator division, mass spectroscopy division, AVF cyclotron division, radioisotope division, and theoretical physics division are summarized. NSA

N72-12723# European Organization for Nuclear Research, Geneva (Switzerland).
HIGH-INTENSITY (10-16) GeV/c NEGATIVE PARTICLE BEAM
N. I. Golovnya, M. I. Grachev, K. I. Gubrienko, E. V. Eremenko, V. I. Kotov, V. S. Seleznev, and Yu. S. Khodyrev [1971] 8 p refs Transl. into ENGLISH from the Russian Report IFVE-OP-70-28
(CERN-Trans-71-16; IFVE-OP-70-28) Avail: AEC Depository Libraries

A beam channel of secondary particles in the momentum range of 10 to 16 GeV/c and beam intensity up to 10 million per pulse is described. Characteristics of the beam are given and properties of the beam channel optic system are discussed. Data

are given on negative pion, negative kaon, antiproton, and antideuteron beams. Author (NSA)

N72-12724# Washington Univ., Seattle. Nuclear Physics Lab.
[NUCLEAR PHYSICS RESEARCH AND INSTRUMENTATION DEVELOPMENT] Annual Report, 1971
1971 200 p refs
(Contract AT(45-1)-1388)
(RLO-1388-139) Avail: NTIS

Research and development progress during the year ending April 15, 1971, is outlined. Topics include accelerator development, ion source development, instrumentation for research, detector systems, computer systems, reactions and scattering with light nuclei, nuclear astrophysics, beta-decay and electron pairs, reactions and scattering, angular correlations, gamma rays from nuclei, fission, and research performed by user or visitor groups. NSA

N72-12725# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
ON SOME PRINCIPLE ASPECTS OF THEORIES OF MULTIPLE PROCESSES
E. I. Daibog, S. A. Gurwitz, and I. L. Rozental 1971 26 p refs
(D-104) Avail: NTIS

The hydrodynamic theory is used for the interpretation of collective interactions. Some difficulties of multiperipheral interpretation are emphasized which may be caused, in particular, by the influence of collective interactions. It is shown that difficulties occur with the fireball model version of multiperipheral theory when this is compared with experimental data, pointing to a preference for the hydrodynamic approach. The feasibility of using models of the hydrodynamic type in field theory is analysed. It is concluded that within the framework of hydrodynamics nucleons can be expected to have peculiar properties; a critical energy from 10 to the 13th power to 10 to the 14th power eV can exist when the characteristics of elementary behavior are changed. ESRO

N72-12726# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
RADIATION SURVEY INSTRUMENTATION Final Report
1 Aug. 1971 13 p
(AMCR Proj. 310-6)
(AD-728455; MTP-8-3-172) Avail: NTIS CSCL 18/4

Procedures are given for evaluating the effectiveness of radiation detection instruments operated in a tactical environment. Author (GRA)

N72-12727# Teledyne Isotopes, Westwood, N.J.
PROJECT STARDUST, VOLUME 2, CHAPTERS 7 AND 8 Final Report
Herbert W. Feely and Milton Trautman 15 Mar. 1971 205 p refs
(Contract DA-49-146-XZ-079; ARPA Order 0172)
(AD-728411; IWL-0001-143-Vol-2; DASA-2166-2-Vol-2) Avail: NTIS CSCL 18/8

A review is presented on the results of analyses of filter and gas samples collected during the course of the program, 1961 to 1967. A summary is given of the conclusions reached concerning the influence of atmospheric processes on the transfer and fallout of radioactive materials injected into the stratosphere. Reference is made to results obtained during Project Hasp also for, in many ways, Project Stardust was a continuation of that program. Author

N72-12728# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
NEW INFORMATION OF Ba-132 LEVELS EXCITED IN THE DECAY OF La-132 AND La-132m
B. Amov, Ts. Vylov, M. Enikova, Zh. Zhelev, N. A. Lebedev, I. Penev, V. I. Fominykh, and E. Herrmann 1971 17 p refs In RUSSIAN
(JINR-P6-5794) Avail: AEC Depository Libraries

Spectra of conversion electrons, of gamma rays, and of gamma gamma coincidences from the decay of La-132 were investigated. As a result, the level scheme of Ba-132 is made more accurate. New levels are introduced, and quantum characteristics are ascribed to a number of these levels. The existence of a great number of levels of negative parity above 2 MeV attracts one's attention. They are supposed to be neutron quasi-particle states, one of their components being anomalous. Author (NSA)

N72-12729# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
NUCLEAR PHYSICS DEPARTMENT Progress Report, 1 Oct. 1969 - 30 Sep. 1970
1970 213 p refs In FRENCH
(CEA-N-1390) Avail: AEC Depository Libraries

Nuclear physics experiments are reported using the Van de Graaff tandem and variable energy cyclotrons, as well as the electron linear accelerator. Research studies range from inelastic and elastic proton and electron scattering to observations of various nuclear particle structures and excited modes in nuclear interactions. G.G.

N72-12730# Naval Academy, Annapolis, Md.
THE USE OF TRANSITION RADIATION FOR THE DETECTION OF HIGHLY RELATIVISTIC CHARGED PARTICLES
Michael J. Kehoe 18 May 1971 44 p refs
(AD-728769; USNA-TSPR-20) Avail: NTIS CSCL 18/4

The objective of this research was to measure the ratio of a charged particle's total energy to its rest mass, or to measure the 'gamma' of a particle using transition radiation. A special design, detector has been constructed to determine the operational prameters for transition radiation. This initial detector design did not work because of anticipated low detecting efficiencies. The design later worked on utilizing a wide gap spark chamber operating in the streamer mode. However, final operational problems of the spark chamber have stalled the work before the acomplishment of this study. The immediate application intended for the detector was to obtain a correlation between the energy and the direction of arrival of very high energy cosmic rays. This correlation would be an important extension of a continuing study of the origins of cosmic rays. The writer believes, once streamer operation is obtained, the application of transition radiation can readily follow to determine a particle's energy. Author (GRA)

N72-12731# Naval Postgraduate School, Monterey, Calif.
GAS TARGET STUDIES AT THE NAVAL POSTGRADUATE SCHOOL LINEAR ACCELERATOR M.S. Thesis
Carter Dow Savage Jun. 1971 45 p refs
(AD-728708) Avail: NTIS CSCL 20/7

A study of the parameters involved in electron scattering experiments with gaseous targets at the Naval Postgraduate School Linear Accelerator was conducted. The parameters included gas densities, effective target thicknesses, and radiative corrections to experimental cross-section calculations. To compare the NPGLINAC with other accelerators, an electron scattering experiment was performed, using a hydrogen-helium gas mixture target, at values of q squared from 0.10 to 0.55 F sup(-2). The resulting charge form factor for helium was fairly consistent with previous experimental models; however, it was concluded that experiments using separate gas targets yield greater accuracy than those using a gas mixture. Author (GRA)

N72-12732# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
[VAN de GRAAFF ACCELERATOR AND MASS SPECTROMETER STUDIES] Final Report, 1 Nov. 1963 - 28 Feb. 1970
Alfred O. Nier 15 Jul. 1971 14 p refs

(Contract Nonr-710(58); NR Proj. 024-009)
(AD-728388; TR-1) Avail: NTIS CSCL 20/8

The final report summarizes work done in Nuclear Physics at the School of Physics and Astronomy. The work was in two areas: A study of nuclear interactions using the 4 Mev Minnesota Van de Graaff Accelerator, and mass spectrometer development and measurements to determine various atomic and nuclear properties. Author

N72-12251*# Iowa Univ., Iowa City. Inst. of Urban and Regional Research.
THE APPLICATION OF REMOTE SENSING TECHNIQUES TO SELECTED INTER AND INTRA URBAN DATA ACQUISITION PROBLEMS
Frank E. Horton *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 12 p (See N72-12248 03-13)
Avail: NTIS CSCL 05K

N72-12647# Centre National de la Recherche Scientifique, Verrieres-Le-Buisson (France). Service de Technologie Spatiale.
SPACEBORNE METAL VAPOR SPECTRAL SOURCES [SOURCES SPECTRALES EMBARQUABLES A VAPEUR METALLIQUE]
D. Bauduin *In* CNES 2nd Symp. on Optics 1969 p 151-153 In FRENCH (See N72-12632 03-23)
Avail: NTIS HC $6.00/MF $0.95

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N72-12733# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
FLOW CONDITIONS INTO THE CATHODE IN THE INTERNAL POSITIVE COLUMN REGIME
Andre Brunet 1971 7 p refs
(ONERA-TP-980) Avail: NTIS

The characteristics of an argon fed hollow cathode discharge are discussed. In the active zone, the cathode wall is between 2,000 and 2,500 K. Under these conditions, the heat supplied to the gas is so great that a thermal choking exists in the cathode and a sonic throat appears at its end. The existence of the sonic throat is determined by measuring the pressure variation into the cathode duct when the vessel pressure changes. Author

N72-12734*# Illinois Univ., Urbana. Antenna Lab.
SINGULAR PERTURBATION METHODS AND THE WARM PLASMA MODEL
S. W. Lee and G. A. Deschamps Aug. 1971 58 p refs
(Grant NGR-14-005-009)
(NASA-CR-124623; SR-18; Rept-71-10; UILU-ENG-71-2546) Avail: NTIS CSCL 20I

The application of techniques of the singular perturbation theory to the analysis of warm plasma is discussed. Typically, the cold plasma model can be applied over wide ranges of parameters and only over narrow ranges forming so-called boundary layers is the warm plasma model used. Simplified equations can be used and the solutions matched on both sides of the layer's boundary. Simple examples to illustrate the solution are presented. The analysis confirms that some results are highly sensitive to the values of: (1) wire radius or gap size for an antenna, (2) temperature of the medium, and (3) incident angle of a plane wave. Author

N72-12735*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ORIGIN OF HOT IONS OBSERVED IN A MODIFIED PENNING DISCHARGE
J. Reece Roth 1971 15 p refs Presented at the 13th Ann. Meeting of the Am. Phys. Soc. Plasma Phys. Div., Madison, Wis., 15-18 Nov. 1971
(NASA-TM-X-67956; E-6654) Avail: NTIS CSCL 20I

Ions with a Maxwellian energy distribution and kinetic temperatures ranging from below 100 eV to several keV are observed in a steady state modified Penning discharge. Observations in the plasma, with capacitive probes at several azimuthal locations, are consistent with the existence of two distinct spokes rotating with different velocities in the sheath between the plasma and the anode ring. The faster (0.5 to 10 MHz) spoke consists of electrons rotating with the E/B drift velocity. The slow (0.1 to 1.0 MHz) spoke consists of ions whose measured thermal velocity is directly proportional to the spoke velocity. The interaction of the two spokes is apparently responsible for the observed electrostatic turbulence and ion thermalization. The anode sheath thickness is smaller than the ion gyrodiameter in this plasma. Thus the ions are in the electric field of the sheath for only a fraction of their orbit, and their E/B drift (spoke) velocity is smaller than that of the electrons. Author

N72-12736# Academy of Sciences (USSR), Moscow.
DYNAMICS OF A DENSE ELECTRON BEAM INJECTED INTO A PLASMA
S. Ye. Rosinskiy and V. G. Rukhlin 1971 28 p refs In RUSSIAN
(PR-81) Avail: NTIS

The question of steady state movement of an electron beam along a magnetic field after leaving the injector is considered. It is shown that a dense beam, propagating in a rarefied plasma, takes on the form of a strongly-crimped cylinder, with a high crimp significantly increasing the initial radius of the beam and with the interval between crimps on the order of the distance of the penetrating electron beam as the period of its cyclotron rotation in the internal magnetic field. General macroscopic parameters, characterizing beam movement, were determined. The influence of polarization properties of the background plasma on the dynamics of a dense beam was studied. Transl. by K.P.D.

N72-12737# Academy of Sciences (USSR), Moscow.
HYDRODYNAMIC PLASMA FLOW UNDER ANISOTROPIC PRESSURE
V. B. Baranov 1971 29 p refs In RUSSIAN
(D-112) Avail: NTIS

A critical review of theoretical papers on investigations of magnetohydrodynamic plasma flows with anisotropic pressure is presented. The following questions are discussed: 1) development of hydrodynamic equations for a collisionless plasma; 2) waves of small amplitude and nonlinear simple waves; 3) collisionless shocks and shock relations; and 4) the hydrodynamics of the interplanetary plasma medium. Author

N72-12738# Groupe de Recherches Ionospheriques, Issy-Les-Moulineaux (France).
THE DOUBLE MICROFIELD PROBE. POSSIBILITIES FOR USING A QUADRIPOLE PROBE TO MEASURE ELECTRIC CURRENTS IN THE MAGNETOSPHERE [LA DOUBLE SONDE A MICROCHAMP. POSSIBILITIES D'UTILISER LA SONDE QUADRIPOLAIRE POUR LA MESURE DE COURANTS ELECTRIQUES DANS LA MAGNETOSPHERE]
Owen Storey, R. Pottelette, and C. Chauliaguet [1971] 18 p refs In FRENCH and ENGLISH
(GRI/TP/104/105) Avail: NTIS

CONTENTS:
1. THE DOUBLE MICROFIELD PROBE O. Storey and C. Chauliague 8 p refs (See N72-12739 03-25)
2. POSSIBILITIES FOR USING A QUADRIPOLE PROBE TO MEASURE ELECTRIC CURRENTS IN THE MAGNETOSPHERE O. Storey and C. Chauliaguet 9 p refs (See N72-12740 03-25)

N72-12739# Groupe de Recherches Ionospheriques, Issy-Les-Moulineaux (France).
THE DOUBLE MICROFIELD PROBE [LA DOUBLE SONDE A MICROCHAMP]
Owen Storey and Charles Chauliaguet *In its* The Double Microfield Probe. Possibilities for using a Quadripole Probe to Meas. Elec. Currents in the Magnetosphere [1971] 8 p refs In FRENCH and ENGLISH (See N72-12738 03-25)
Avail: NTIS

It is suggested that the electron density and temperature of a plasma could be determined by measuring, as a function of frequency, the cross-spectrum of the random signals received on two small dipole antennas immersed in this medium. The spectrum was studied for the case of a collisionless plasma in thermal equilibrium, with no magnetic field. It exhibits a maximum slightly above the plasma frequency; the greater the distance between the antennas in comparison with the Debye length, the sharper is this maximum. Author

N72-12740# Groupe de Recherches Ionospheriques, Issy-Les-Moulineaux (France).
POSSIBILITIES FOR USING A QUADRIPOLE PROBE TO MEASURE ELECTRIC CURRENTS IN THE MAGNETOSPHERE [POSSIBILITES D'UTILISER LA SONDE QUADRIPOLAIRE POUR LA MESURE DE COURANTS ELECTRIQUES DANS LA MAGNETOSPHERE]
Owen Storey and Raymond Pottelette *In its* The Double Microfield Probe. Possibilities for using a Quadripole Probe to Meas. Elec. Currents in the Magnetosphere [1971] 9 p refs In FRENCH and ENGLISH (See N72-12738 03-25)
Avail: NTIS

The transfer impedance of a quadripole probe as affected by its motion with respect to the ambient plasma was studied at one of the oblique resonances. The results offer the possibility of measuring, in the magnetosphere, the flow velocity of the thermal electrons parallel to the magnetic field, and hence the electron current. Author

N72-12741*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
LOCAL-TIME SURVEY OF PLASMA AT LOW ALTITUDES OVER THE AURORAL ZONES
L. A. Frank and K. L. Ackerson Aug. 1971 45 p refs
(Contracts NAS5-10625; NAS1-8141; NAS1-2973; Grant NGL-16-001-002; Contract N00014-68-A-0196-0003)
(NASA-CR-124569; Rept-7I-40) Avail: NTIS CSCL 20I

A local-time survey of the low energy proton and electron intensities precipitated into the earth's atmosphere during periods of magnetic quiescence was constructed. A typical, individual satellite crossing of this region in each of eight local-time sectors was selected from a library of similar observations with the polar-orbiting satellite Injun 5. The trapping boundary for more energetic electron intensities, E > 45 keV, is a natural coordinate for delineating the boundary between the two major types of lower energy, 50 < or = E < or = 15,000 eV. The main contributors to electron energy influx are inverted V precipitation poleward of the trapping boundary and the plasma sheet intensities equatorward. These are interpreted in terms of a magnetospheric model. Author

N72-12742*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
INJUN 5 OBSERVATIONS OF MAGNETOSPHERIC ELECTRIC FIELDS AND PLASMA CONVECTION
Donald A. Gurnett Sep. 1971 33 p refs Presented at the summer Advanced Study Inst. on Earth's Particles and Fields, Cortina, Italy, Sep. 1971
(Contracts NAS5-10625; NAS1-8141; NAS1-8144(f); NAS1-8150(f); Grant NGL-16-001-043(97); Contract N00014-68-A-0196-0003)
(NASA-CR-124544; Rept-7I-46) Avail: NTIS CSCL 20I

Recent measurements of magnetospheric electric fields with the satellite Injun 5 have provided a comprehensive global survey of plasma convection at low altitudes in the magnetosphere. A persistent feature of these electric field observations is the occurrence of an abrupt reversal in the convection electric field at auroral zone latitudes. The plasma convection velocities associated with these reversals are generally directed east-west, away from the sun on the poleward side of the reversal, and toward the sun on the equatorward side of the reversal. Convection velocities over the polar cap region are normally less than those observed near the reversal region. The electric field reversal is observed to be coincident with the trapping boundary for electrons with energies E greater than 45 keV. Author

N72-12743*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DEVELOPMENT AND INITIAL OPERATING CHARACTERISTICS OF THE 20 MEGAWATT LINEAR PLASMA ACCELERATOR FACILITY
Arlen F. Carter, Willard R. Weaver, Donald R. McFarland, and George P. Wood Washington Dec. 1971 34 p refs
(NASA-TN-D-6547; L-7932) Avail: NTIS CSCL 20I

A 20-megawatt linear plasma accelerator facility, a steady flow, Faraday-type plasma accelerator facility for high velocity aerodynamic testing, was constructed, developed, and brought to an operational status. The accelerator has a 63.5-mm-square and 0.5-meter-long channel and utilizes nitrogen-seeded with 2 % mole fraction of cesium vapor. Modification of the original accelerator design characteristics and the improvements necessary to make the arc heater a suitable plasma source are described. The measured accelerator electrode current distribution and the electrode-wall potential distributions are given. The computed and the measured values are in good agreement. Measured pitot pressure indicates that an accelerator exit velocity of 9.2 km/sec, is obtained with 30 of the 36 electrode pairs powered and corresponds to a velocity increase to about 2 1/4 times the computed entrance velocity. The computed stagnation enthalpy at the accelerator exit is 92 MJ/kg, and the mass density corresponds to an altitude of about 58 km. The 92 MJ/kg stagnation enthalpy corresponds to a kinetic energy content at low temperature equivalent to a velocity of 13.6 km/sec.
Author

N72-12744# Joint Publications Research Service, Washington, D.C.
ELECTRIC CONDUCTIVITY AND CURRENT HEATING OF PLASMA IN A STRONG MAGNETIC FIELD
P. Ya. Burchenko, Ye. D. Volkov, V. A. Rudakov, V. L. Sizonenko, and K. N. Stepanov 6 Dec. 1971 12 p refs Transl. into ENGLISH of Russian report IAEA/CN-28/H9 Presented at the 4th Conf. on plasma Phys. and Controlled Nucl. Fusion Res., Madison, Wis., 17-23 Jun. 1971; sponsored by IAEA
(JPRS-54619; IAEA/CN-28/H9) Avail: NTIS

Current heating studies on plasmas established a significant resistance anomaly at electric fields smaller than or equal to Dreiser's critical field. Experiments show that increased field strength produces plasma current saturation with increased rate of growth for the magnetic signal. The sum of electronic and ionic temperatures determined from diamagnetic measurements considerable exceeds that corresponding to measurements of conductivity in approximation of purely Coulombic collisions. The observed anomaly in the resistance of a magnetized plasma with longitudinal current is attributed to the development of an ionosonic instability. G.G.

N72-12745# Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires.
PARAMETER STUDY FOR A TRANSIT TIME MAGNETIC PUMPING EXPERIMENT IN A TORUS
M. Brambilla and S. Giuffre Apr. 1971 48 p refs Sponsored by EURATOM
(EUR-CEA-FC-595) Avail: AEC Depository Libraries

The balance equations for the density, ion temperature, and electron temperature in a toroidal plasma, including TTMP heating, are written and solved numerically. The loss terms

appropriate either to a stellarator or to a Tokamak are discussed. The feasibility of a TTMP heating experiment on a machine comparable with existing ones is proved in principle, and its performance is evaluated. Author (NSA)

N72-12746# Academy of Sciences (USSR), Leningrad. Technical Physics Inst.

RATIO OF LONGITUDINAL AND TRANSVERSE DIFFUSION COEFFICIENTS IN ARGON SHF DISCHARGE

V. N. Budnikov, K. M. Novik, and A. A. Obukhov 1971 9 p refs In RUSSIAN; ENGLISH summary

(NP-18916) Avail: AEC Depository Libraries

Results were obtained from the analysis of longitudinal density distribution outside the active region of the microwave discharge. The experiments were carried out with axial magnetic field about 3000 Oe. The discharge tube was 70 cm long and 2.5 cm in diameter. Author (NSA)

N72-12747# Academy of Sciences (USSR), Leningrad. Technical Physics Inst.

MEASUREMENT OF TRANSVERSE DIFFUSION COEFFICIENTS IN SHF PLASMA

D. G. Bulyginskii, M. I. Vildzhyunas, B. P. Poloskin, and B. A. Utochkin 1971 20 p refs In RUSSIAN; ENGLISH summary

(NP-18917) Avail: AEC Depository Libraries

Plasma created in a straight mirror is discussed. The characteristics of the plasma generated by electron cyclotron resonance are given. Measurements were made of the normal diffusion coefficient D due to azimuthal fluctuating electric fields E sub phi versus magnetic field H and pressure P. The results presented show that D is close to the Bohm diffusion at high pressure. This was confirmed by probe measurements treated according to Bertotti's theory. But at lower pressure, when the electron mean free path becomes comparable to the trap dimension, a sharp rise in the average value of E sub phi squared is observed. The latter may be accounted for by the appearance of a group of fast electrons accelerated by the resonance wave. The experimentally observed anomalous diffusion is considered to be due to the low frequency broad spectrum turbulence, which develops from the drift waves near the plasma surface. Author (NSA)

N72-12748# Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre D'Etudes Nucleaires.

SYNTHESIS REPORT ON THE PROJECT OF NEUTRAL PARTICLE INJECTION IN A QUADRUPOLAR COIL [RAPPORT DE SYNTHESE SUR LE PROJET D'INJECTION DE NEUTRES DANS UN PUITS QUADRUPOLAIRE]

R. Dei-Cas, F. Hennion, J. Tachon, and F. P. G. Valckx Mar. 1971 31 p In FRENCH

(EUR-CEA-FC-591) Avail: AEC Depository Libraries

A review is made of the work done for preparing the experiment on neutral particle injections in a quadrupolar coil. The coil, the cryostats, and the injector are described. The aim of this experiment is to confine a hot ion plasma and to reach a collisional equilibrium state in open devices. NSA

N72-12749# Scientific Research Inst. of Electro-Physical Apparatus, Leningrad (USSR).

GENERAL RULES FOR CURRENT PROCESSES IN PLASMA HEATING IN PULSED Z-DISCHARGES

L. V. Dubovoi 1971 10 p refs In RUSSIAN; ENGLISH summary

(NP-18947) Avail: AEC Depository Libraries

It is shown that in plasma heating processes in pulsed Z discharges, the gas-kinetic pressure nT of particles is related to the discharge current field B sub phi by the general law nT is approximately equal to Beta sub phi (B(2) sub phi/g pi), (where Beta sub phi = cost approximately 1), for most of the present-day experiments. Conclusions from this relation and generality of its character are discussed. Author (NSA)

N72-12750# Akademiya Nauk SSSR, Novosibirsk. Inst. Yadernoi Fiziki.

STUDIES OF PLASMA TURBULENCE BY MEANS OF CHARGED PARTICLE BEAM

V. S. Koidan, A. G. Ponomarenko, A. I. Rogozin, and D. D. Kyutov 1970 22 p refs In RUSSIAN

(IYAF-7-70) Avail: AEC Depository Libraries

Calculations were carried out on the interaction of a beam of charged particles with the turbulent oscillations of a plasma, and it was found that for given conditions there may be observed both spatial broadening and spread of the particles of the beam longitudinally according to energy after passage through the turbulent plasma. A relationship was obtained that links the energy density of the turbulent oscillations with the amount of beam broadening and its energy dispersal. An experiment is described for probing the turbulent plasma of a direct discharge with a 50-kV proton beam. The radial broadening of the beam is detected as that associated with ion beam scattering by turbulent plasma oscillations. The amount of beam broadening is determined by the energy density of the oscillating plasma. The possibility of applying this method to the investigation of a turbulent plasma is discussed. Author (NSA)

N72-12751# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

SURVEY OF STUDIES OF LASER PRODUCED PLASMAS AT THE IPP GARCHING

R. Sigel, S. Witkowski, H. Baumhacker, K. Buechl, K. Eidmann, H. Hora, H. Mennicke, P. Mulser, D. Pfirsch, and H. Salzmann Jan. 1971 26 p refs

(IPP-4/9) Avail: AEC Depository Libraries

A status report as of November 1970 on experimental and theoretical studies of laser-produced plasmas at the IPP is given. Experimental investigations of plasma production by nanosecond laser pulses from targets of solid hydrogen and deuterium, of Raman scattering from these materials, and of plasma production by picosecond laser pulses are described. The theoretical part comprises numerical studies of the expansion of a two-temperature plasma T sub e not equal to T sub i and of a multicomponent plasma and also calculations of the fusion rate of an inertially confined plasma. Author

N72-12752# Instituto Politecnico Nacional, Mexico City. Souela Superior de Fisicay Matematicas.

CONDUCTIVITY AT HIGH FREQUENCIES OF A COMPLETELY IONIZED PLASMA WITH ION-ION CORRELATIONS M.S. Thesis

Fray de Landa Castillo Alvarado 1970 64 p refs In SPANISH

(NP-18805) Avail: AEC Depository Libraries

The frequency dependence on the resistance for frequencies higher than omega sub c equal to 2 pi/t sub D (where omega sub c is the cyclotron frequency and t sub D is the accumulated dispersion time at 90 deg) was studied. The approximation formulations describing the processes ocurring in the plasma are discussed. The validity of the Vlasov equation for the conductivity is considered. The Dawson-Oberman model is established. The conductivity of a completely ionized plasma with ion-ion correlation is developed mathematically. The impedance is calculated analytically for the asymptotic forms. Graphs of the resistivity are presented as a function of omega/omega sub p, where omega sub p is the plasma frequency. Author (NSA)

N72-12753# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.

PRECURSOR IONIZATION FRONTS AHEAD OF EXPANDING LASER PLASMAS

David W. Koopman Jun. 1971 30 p refs

(Contract AT(40-1)-3819)

(ORO-3819-4; BN-700) Avail: NTIS

Fast ionization fronts were experimentally observed to propagate ahead of a laser-produced plasma expanding into low-density background gas. The ionizing wave has a velocity of .3 to 3 x 10 to the 8th power cm/sec and a thickness of 1 to

10 cm, both of which increase with radius of propagation. Langmuir probe and microwave diagnostics indicate that the wave increases the initial photoionization density by a factor of about 3. Potential fluctuations exist within the wave that can accelerate electrons to energies above the ionization threshold. Equations describing a collisional ionizing electron wave are solved in an approximate manner to yield relations that agree with many features of the measured phenomena. Author (NSA)

N72-12754# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
COUNTER-STREAMING LASER-PRODUCED PLASMAS Progress Report, 1 Jun. 1970 - 30 Apr. 1971
David W. Koopman Jun. 1971 39 p refs
(Contract AT(40-1)-3819)
(ORO-3819-3; BN-698) Avail: NTIS

Preliminary data are given for the following research areas: (1) Langmuir probes in flowing plasmas,(2) magnetic field assembly,(3) photoionization,(4) anomalous plasma attenuation, and(5) ion precursors. NSA

N72-12755# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
HIGH PRESSURE PLASMA JET TESTS
W. A. Rinehart, R. R. Williams, and R. A. Williamson Jun. 1971 47 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.
(Contract Sandia-48-8766)
(SC-CR-715084) Avail: NTIS

A high impact pressure (HIP) arc heater facility to evaluate the performance of various graphites in a high pressure environment. These tests were performed at a nominal arc heater bulk enthalpy of 2000 Btu/lb and at model impact pressures of 51, 72, 108, 128 and 165 atmospheres using a 3/8 in. throat diameter Mach 1.7 contoured nozzle. Five models were tested in each run and two runs each were made at the high and low pressure conditions. The models were 0.3 in. diameter cylinders and had either a hemispheric or conic tip prior to testing. A model recession servo compensator system was employed which maintained the tip of each model at a virtually fixed position from the nozzle exit during the test. In this manner the model incremental feed rate was then translated into model recession rate. Average recession rates determined with this method varied from approximately 0.09 in/sec at a model impact pressure of 51 atm to 0.34 in/sec at the 165 atm condition. Author

N72-12756# European Space Research Inst., Frascati (Italy).
LOW FREQUENCY ELECTROSTATIC WAVES IN A TURBULENT PLASMA
Marino Dobrowolny 1971 41 p refs Submitted for publication
Avail: NTIS

A procedure was developed to study electrostatic dispersion properties of a turbulent, low Beta, inhomogeneous collisionless plasma. The formalism was applied to a study of the effect of an ion acoustic turbulence parallel to the magnetic lines of force on the dynamics of low frequency waves (frequencies below the ion cyclotron frequency) of the drift type. It was found that even a weak turbulence can significantly modify the drift wave dispersion properties. In particular, dynamic stabilization of certain drift instabilities can be achieved, but new instabilities driven by the turbulence are obtained. Detailed discussion of such possibilities is given in the two regimes of the phase velocity parallel to magnetic lines (for the low frequency wave), that above the electron thermal speed, and that intermediate between the ion and electron thermal speeds. Author (ESRO)

N72-12757# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.
MPD ARC JETS IN EXTERNAL MAGNETIC FIELDS WITH HALL EFFECT [FREMDMAGNETISCH BEEINFLUSSTE PLASMAFREISTRAHLEN MIT AXIALEM STROM UND HALL EFFECT]
K. Robert 1971 89 p refs In GERMAN; ENGLISH summary
(DLR-FB-71-21) Avail: NTIS; DFVLR, Proz, West Ger.: 23,90 DM

The steady inviscid, and isothermal flow of MPD arc jets under the influence of external axisymmetric magnetic fields is analyzed three-dimensionally with Hall-effect included. The nondimensionalized fundamental equations of magnetogasdynamics are solved by means of a first-order perturbation method, using as parameters both the magnetic pressure number and the magnetic Reynolds number. For Hall parameters much smaller than one and for external magnetic fields of weak curvature, closed form solutions for the electric current density as well as plasma velocity and mass density are obtained and discussed. Author (ESRO)

N72-12758# Naval Research Lab., Washington, D.C. Plasma Physics Div.
NUMERICAL SIMULATION OF PLASMAS WITH PERIODIC SMOOTHING IN PHASE SPACE
Jacques Denavit May 1971 55 p refs
(NRL Proj. 77H02-27)
(AD-726184; NRL-MR-2256) Avail: NTIS CSCL 20/9

The paper presents a hybrid method of numerical simulation of collisionless plasmas in which weighted particles are advanced as in particle simulations, but in which the distribution function is reconstructed periodically by a local averaging operation as in numerical solutions of the Vlasov equation. The rates of diffusion resulting from repeated averaging of the distribution function are estimated. These rates indicate that it is possible to minimize the effects of both beaming instabilities and diffusion by properly choosing the frequency of reconstruction of the distribution function. A computer code was written to implement this method and numerical solutions of two-stream instability problems are presented. Author (GRA)

N72-12759# Illinois Univ., Urbana. Coordinated Science Lab.
OPTICAL WRITE IN TECHNIQUES FOR THE PLASMA DISPLAY PANEL M.S. Thesis
Larry Francis Weber May 1971 75 p refs
(Contract DAAB07-67-C-0199)
(AD-726251; R-510; UILU-ENG-71-2213) Avail: NTIS CSCL 09/5

Techniques of changing the state of plasma display cells with externally applied light are presented. Optical write-in offers the advantage of high speed parallel data transfer from a photographic transparency to a plasma display panel. It is established that light incident on a plasma cell causes a photoemission from the inner glass surface. The emitted electrons perturb the wall voltage and cause a change in state. The intensity of light needed to change the state of cells can be reduced, without changing the solid panel materials, by two techniques. Electron avalanches initiated by the photoelectrons can be used to decrease the light needed by a factor of 100. By flashing light during the plasma display cell gas discharge, the intensity of the light can be further reduced. Experimental results that suggest an explanation of the continuous discharge behavior exhibited by pure Ne are presented. Results that indicate why Owens-Illinois Digivue panels are less sensitive to external light are given. Author (GRA)

N72-12760# United Aircraft Corp., East Hartford, Conn. Research Labs.
INVESTIGATION OF THE PLASMA PROPERTIES OF HIGH ENERGY GAS DISCHARGE LASERS Final Report, 1 Apr. 1969 - 30 Apr. 1971
W. L. Nighan, Walter J. Wiegand, Michael C. Fowler, and Robert H. Bullis 29 Jun. 1971 68 p refs
(Contract N00014-69-C-0309; NR Proj. 016-300)
(AD-725894; K-920833-5) Avail: NTIS CSCL 20/5

The report summarizes the results of a two-year research investigation directed toward identification and evaluation of the

fundamental physical phenomena of importance to the operation of electrically excited CO2 lasers. An analysis of electron kinetics processes was employed to determine electron energy distributions and electron-molecule collision rates in CO2 laser plasmas. This information, when combined with a detail analysis of molecular kinetic processes, permitted calculation of such important CO2 laser properties as small signal gain, saturation intensity, optical power density, and overall laser efficiency for a variety of experimental conditions. Supplementing the analytical portion of the program, detailed measurements were made of plasma and laser properties in a CO2 laser discharge. Comparison of calculated and measured values of small signal gain yielded very good agreement over a range of discharge conditions, thus indicating that the analytical model, developed in connection with this study, accurately represents the features of the important physical phenomena influencing CO2 electric discharge laser performance. A number of major publications resulted from the present research investigation. Reprints of these publications are included in this report as Appendices I through VI.
Author (GRA)

N72-12761# Stanford Univ., Calif. Inst. for Plasma Research.
EXCITATION OF ELECTROSTATIC WAVES IN NON-UNIFORM MAGNETOPLASMAS Final Technical Report
John Howard Brownell Apr. 1971 215 p refs
(Contract F33615-67-C-1284; AF Proj. 7073-00-03)
(AD-728652; SU-IPR-415; ARL-71-0062; DOD-Element-61102F; DOD-Subelement-681301) Avail: NTIS CSCL 20/9

In order to understand the experimentally observed stabilization of a plasma column by high frequency fields, the process of r-f plasma excitation and energy absorption is analyzed rigorously. The electric field excited in a non-uniform magnetoplasma slab (with B perpendicular to the density gradient) by an external source is calculated, and the impedance presented by a grid-plasma system is found. Electrostatic waves which propagate across the magnetic field parallel to the density gradient are considered and particular attention is paid to frequencies close to the upper hybrid frequency. An integral equation in wave number space, which is exact within the assumption of neutrality and of low plasma pressure, is derived for the electric field, and it is shown that a variational principle exists for the admittance of the grid-plasma system. In addition, a differential equation for E(k) is found. These two methods take the entire real k-axis into account, and therefore it is possible to formulate a validity criterion for the long wavelength method used in most previous work.
Author (GRA)

N72-12762# Naval Research Lab., Washington, D.C.
INTERACTION OF A HIGHLY ENERGETIC ELECTRON BEAM WITH A DENSE PLASMA Memorandum Report
Selig Kainer, John Dawson, Timothy Coffey, and Shanny Ramy Jul. 1971 33 p refs
(NRL Proj. 77H02-27; DASA Proj. NWER-HC04001)
(AD-728379; NRL-MR-2283) Avail: NTIS CSCL 20/9

The interaction of an electron beam with a relatively dense background plasma was examined through numerical experiments, where the beam velocity is much greater than the thermal velocities. It is shown that the initial growth of the unstable waves is described by the two-stream instability and that the phenomena can be separated into two regions (high and low density), depending on whether or not merging of the space averaged velocity distributions occurs during the growth of the initially most unstable wave. The occurrence of these regions is shown to follow from energy and momentum considerations. The long time behavior of the low density regime, where the merging does not take place during the initial growth of the instability is shown to be described quite well by quasi-linear theory.
Author (GRA)

N72-12763# Institute of Nuclear Research, Warsaw (Poland).
PLASMA APPLICATION IN CHEMICAL TECHNOLOGY. 2: PLASMA GENERATION METHODS: PLASMOTRONS
Bohdan Kalinowski and Juliusz Borysowski 1971 27 p refs In POLISH; ENGLISH summary
(INR-1285) Avail: AEC Depository Libraries

The history of plasma generators is briefly discussed. General designs and the construction of working systems are reviewed.
Author (NSA)

N72-12764# Naval Academy, Annapolis, Md.
EXPERIMENTAL COMPARISON OF WATER COOLING AND TRANSPIRATION COOLING OF PLASMA GENERATOR CONSTRICTORS
Daniel L. Whitford 18 May 1971 91 p refs
(Proj. Trident Scholar)
(AD-728761; USNA-TSPR-23) Avail: NTIS CSCL 20/9

Water cooling and transpiration cooling in plasma generator constrictors were investigated in this study. A comparison was obtained of the two types of cooling methods in order to determine the advantages of each and the range of their applicability. The comparison was made on the basis of similar device geometry and constant power. Argon was the propellant gas. Detailed findings are enclosed.
Author (GRA)

N72-12765# Harry Diamond Labs., Washington, D.C.
EFFECT OF NARROW, VERTICAL SLOTS IN X-BAND WAVEGUIDE ON PLASMA PROPAGATION COEFFICIENTS
Frank L. Tevelow and F. J. Tischer Apr. 1971 23 p refs
(DA Proj. 1T0-61102-B-11-A; HDL Proj. RPH85; HDL Proj. RPH86)
(AD-728107; HDL-TR-1544; AMCMS-Code-501B.11.85100) Avail: NTIS CSCL 20/9

Transmission characteristics are considered for a plasma test section consisting of a rectangular channel orthogonally intersecting a rectangular waveguide. Reflection and transmission coefficients for closed and slotted waveguide (CWG, SWG) are compared at 9.385 and 10.0 GHz with those of the test section, taking into account the wall openings due to the channel. These quantities are presented graphically for several waveguide widths in terms of the normalized plasma frequency squared (omega squared sub p/omega squared), normalized collision frequency (nu/omega), and width of the opening in the side walls equal to the width of the channel (L). The results show that for $L > 0.08$ Lambda sub 0, meaningful data require that the effects of the wall openings be taken into account. The differences in the transmission coefficients for the CWG and the SWG increase for increasing value of collision frequency, decreasing value of electron density, increasing waveguide width, and increased width of the opening.
Author (GRA)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N72-12766# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
IDEAL THREE-PHASES MODEL AND THE MELTING OF MOLECULAR CRYSTALS AND METALS
Yasuaki Hiwatari and Hirotsugu Matsuda Aug. 1971 57 p refs Submitted for publication to Prog. Theor Phys.
(RIFP-129) Avail: NTIS

Thermodynamic properties of an ideal, three-phase model were studied, using the results of Monte Carlo calculations. These properties were compared with data obtained by experiment. It was found that the melting equations of solidified inert gases are represented well if n is set approximately = 15. Melting behaviors of alkali metals which differ systematically from those of solidified inert gases can be accounted for in the equations, after assigning a smaller value to n, such that $4 < n < 5$. The implication of the difference in value of n in the two families of

substances, as well as the limit of applicability of this model, is discussed. Author

N72-12767*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADIATION DAMAGE IN MOS INTEGRATED CIRCUITS, PART 1
Vitaly Danchenko Sep. 1971 64 p refs Submitted for publication
(NASA-TM-X-65764; X-711-71-410-Pt-1) Avail: NTIS CSCL 09C

Complementary and p-channel MOS integrated circuits made by four commercial manufacturers were investigated for sensitivity to radiation environment. The circuits were irradiated with 1.5 MeV electrons. The results are given for electrons and for the Co-60 gamma radiation equivalent. The data are presented in terms of shifts in the threshold potentials and changes in transconductances and leakages. Gate biases of -10V, +10V and zero volts were applied to individual MOS units during irradiation. It was found that, in most of circuits of complementary MOS technologies, noticable changes due to radiation appear first as increased leakage in n-channel MOSFETs somewhat before a total integrated dose 10 to the 12th power electrons/sg cm is reached. The inability of p-channel MOSFETs to turn on sets in at about 10 to the 13th power electrons/sq cm. Of the circuits tested, an RCA A-series circuit was the most radiation resistant sample. Author

N72-12768*# Techtran Corp., Glen Burnie, Md.
CATION-RICH OXIDES. THE CRYSTAL STRUCTURE OF LiInO3
Frank Stewner and Rudolf Hoppe Washington NASA Dec. 1971 22 p refs Transl. into ENGLISH from Z. Anorg. Allgem. Chem (Leipzig), v. 374, no. 3, 1970 p 239-258
(Contract NASw-2037)
(NASA-TT-F-14045) Avail: NTIS CSCL 20B

Li3In03 crystallizes trigonal, P3cl, with a=9.606 sub 4, c=10.42 sub 0 A, c/a=1.064 sub 7, Z=12 and In sub 1 in 2(a), In sub 2: 4(d), In sub 3: 6(f), and O sub 1, O sub 2, O sub 3, Li sub 1, Li sub 2, Li sub 3 each in 12(g). According to Li sub 2(4) In sub 2/3(6) vacancy 1/3 O sub 2, Li3In03 is a stuffed derivative of a layer structure of the CdJ sub 2 type. Calculations of the Madelung part of lattice energy (MAPLE) assure the localization of Li by X-ray work and explain why In sub 2, O sub 1, and O sub 3 depart from ideal positions. Author

N72-12769*# Virginia Univ., Charlottesville. Dept. of Electrical Engineering.
APPLICATION OF THIN FILMS EXTREMELY HIGH FREQUENCIES
Robert L. Ramey Jul. 1971 37 p refs
(Grant NGR-47-005-001)
(NASA-CR-112005; EE-4012-113-71U) Avail: NTIS CSCL 20L

The use of thin film irises to control the beam direction from an array of microwave horns is discussed. The phenomenon is based on the finite transmission of electromagnetic energy through thin films. Diagrams of characteristic waveguides and numerical analyses of the irises are presented. Author

N72-12770# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.
NOTE ON THE TWO-DIPOLE PROBLEM
M. J. Mandell May 1971 15 p refs
(Contract AT(30-1)-3699)
(NYO-3699-55) Avail: NTIS

The problem of two free-rotor quantum dipoles with fixed interparticle distance is considered. For various values of interaction strength, the correlation and the parallel and perpendicular susceptibilities are calculated as a function of temperature, and the zero-temperature polarization is calculated as a function of electric field. The nature of the elementary excitations of a lattice of electric dipoles are discussed. These results are applicable to understanding the observed susceptibility maximum in doped alkali halides, and the properties of such molecular crystals as the hydrogen halides. Author

N72-12771# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
INFLUENCE OF LATTICE DEFECTS ON BACKSCATTERING OF PROTONS AND HELIUM IONS FROM NIOBIUM SINGLE CRYSTALS
H. Schulze Dec. 1970 38 p refs In GERMAN; ENGLISH summary
(IPP-7/3) Avail: AEC Depository Libraries

The backscattering of 100-keV protons and helium ions from a niobium single crystal was measured by the single- and double-alignment techniques as a function of both temperature and bombardment dose. In the investigated range from -80 to 800 C, the measured intensities of H(+) backscattered from an annealed single crystal agree well with Linhard's theory of the temperature dependence of backscattering. From the backscattering intensities measured by the single- and double-alignment techniques it is possible to determine the lattice-defect concentration in the surface and in the first hundred atomic layers. Author (NSA)

N72-12772# Naval Research Lab., Washington, D.C.
NUCLEAR APPLICATIONS PROGRAM Progress Report, 1 Jul. 1969 - 31 Dec. 1970
E. A. Wolicki Jul. 1971 108 p refs
(AD-728380; NRL-MR-2286) Avail: NTIS CSCL 20/12

Results reported herein were obtained in the period 1 July 1969 to 31 December 1970. Research in materials analysis was performed at the 5-MV Van de Graaff and the 50 MeV Linac. Radioactivation experiments were performed with charged particle and bremsstrahlung beams. Prompt radiation techniques were studied with neutron, charged particle, and bremsstrahlung beams. The prompt radiations measured included fission neutrons, gamma rays from resonance nuclear reactions, Coulomb backscattered and nuclear reaction particles, and heavy ion induced x rays. The techniques were applied to both volume and surface analyses and to minor constituents as well as to trace elements. In ion implantation a joint program was established with the Solid State Technology Branch of the Electronics Division in order to apply ion implantation techniques to the fabrication of new or improved solid state electron devices. Both the 5-MV Van de Graaff and a 60 kV accelerator system were employed in a large variety of experiments and feasibility tests. The following ion beams were used at both low (keV) and high (MeV) energies: H-1, B-11, N-14, O-16, and Ar-40; implanted materials included GaP, Si, BaTiO3, Triglycine Sulfate, Alkali halide crystals, SiO2, GaAs, SiC, and Cd3P2.
Author (GRA)

N72-12773# North Carolina State Univ., Raleigh.
AN ANALYTICAL MODEL OF LARGE DEFORMATION EFFECTS IN CRYSTALLINE AGGREGATES
Kerry S. Havner Jul. 1971 32 p refs
(Contract N00014-68-A-0187; NR Proj. 064-504)
(AD-728435; TR-71-4) Avail: NTIS CSCL 20/12

A microcontinuum model of (rate-independent) deformation in crystalline aggregates under macroscopically uniform, quasi-static loading is presented, corresponding to the general problem of instantaneous response from a deformed state. A rational discretization, which includes all convection and rotation effects at large strain, is fully developed, and questions of existence and uniqueness of solution are investigated through consideration of alternative quadratic programming problems equivalent to the governing equations. Author (GRA)

N72-12774# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
EFFECT OF AMBIENT GASES ON THE ELECTRICAL

PROPERTIES OF THIN PbSe EPITAXIAL FILMS Final Technical Report
George Francis McLane Jun. 1971 233 p refs
(Contract DAHC04-68-C-0023; DA Proj. 2O0-61102-B-33-G)
(AD-728118; AROD-7018-4-E; Rept-72-02) Avail: NTIS CSCL 20/2

The report investigates the effect of various ambient gases on the electrical properties of PbSe epitaxial films evaporated onto NaCl substrate. Hall coefficient, electrical conductivity, and magnetoresistance measurements were made as a function of film temperature and ambient gas uptake by the film. Ambient gas uptake kinetic measurements were also made. The nature and relative amount of ambients could be determined via a residual gas analyzer. Atomic hydrogen (H) was produced by interacting a hot filament with hydrogen gas, hydrocarbon diffusion pump oil, or alcohol, and was found to make freshly-evaporated films with (clean) surfaces and air-exposed films n-type. H uptake by the films is inadequately described by the surface model. GRA

N72-12775# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
A STUDY ON SURFACE TRANSPORT IN DEGENERATE SEMICONDUCTORS Final Report, 15 Mar. 1968 - 30 Jun. 1971
Jay Zemel 30 Jun. 1971 8 p refs
(Contract DAHC04-68-C-0023; DA Proj. 2O0-61102-B-33-G)
(AD-728131; AROD-7018-6-E; Rept-72-04) Avail: NTIS CSCL 20/12

The stated objective of this research program was the study of the surface properties of degenerate semiconductors based on the lead chalcogenides. The interest in this class of materials arises from their use as infrared sensing materials. In recent years, the growth of epitaxic film usage made it important to establish how gases affected the properties of the films and to see if surface quantization was, in fact, important. This effort has had two important consequences: it established the importance of oxygen and atomic hydrogen on the electrical properties of the lead chalcogenides; and, a working model for chemical sensing was evolved. Author (GRA)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N72-12776*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMODYNAMIC PROPERTIES AND THEORETICAL ROCKET PERFORMANCE OF HYDROGEN TO 100,000 K AND 1.01325 X 10 TO THE 8TH POWER N/SQ M
R. W. Patch Washington 1971 114 p refs
(NASA-SP-3069) Avail: NTIS CSCL 21I

The composition and thermodynamic properties were calculated for 100 to 110,000 K and 1.01325 x 10 to the 2nd power to 1.01325 x 10 to the 8th power N/sq m for chemical equilibrium in the Debye-Huckel and ideal-gas approximations. Quantities obtained were the concentrations of hydrogen atoms, protons, free electrons, hydrogen molecules, negative hydrogen ions, hydrogen diatomic molecular ions, and hydrogen triatomic molecular ions, and the enthalpy, entropy, average molecular weight, specific heat at constant pressure, density, and isentropic exponent. Electronically excited states of H and H2 were included. Choked, isentropic, one-dimensional nozzle flow with shifting chemical equilibrium was calculated to the Debye-Huckel and ideal-gas approximations for stagnation temperatures from 2500 to 100,000 K. The mass flow per unit throat area and the sonic flow factor were obtained. The pressure ratio, temperature, velocity, and ideal and vacuum specific impulses at the throat and for pressure ratios as low as 0.000001 downstream were found. For high temperatures at pressures approaching 1.01325 x 10 to the 8th power N/sq m, the ideal-gas approximation was found to be inadequate for calculations of composition, precise thermodynamic properties, and precise nozzle flow. The greatest discrepancy in nozzle flow occurred in the exit temperature, which was as much as 21 percent higher when the Debye-Huckel approximation was used. Author

N72-12777*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SHUTTLE CRYOGENIC SUPPLY SYSTEM OPTIMIZATION STUDY Interim Presentation
30 Sep. 1971 179 p
(Contract NAS9-11330)
(NASA-CR-124626; LMSC-A995668) Avail: NTIS CSCL 21I

Technical information on different cryogenic supply systems is presented for selecting representative designs. Parametric data and sensitivity studies, and an evaluation of related technology status are included. An integrated mathematical model for hardware program support was developed. The life support system, power generation, and propellant supply are considered. The major study conclusions are the following: Optimum integrated systems tend towards maximizing liquid storage. Vacuum jacketing of tanks is a major effect on integrated systems. Subcritical storage advantages over supercritical storage decrease as the quantity of propellant or reactant decreases. Shuttle duty cycles are not severe. The operational mode has a significant effect on reliability. Components are available for most subsystem applications. Subsystems and components require a minimum amount of technology development. N.E.N.

N72-12778# Naval Weapons Center, China Lake, Calif.
A THERMOVISCOELASTIC STUDY OF A SOLID ROCKET PROPELLANT GRAIN Technical Report, May 1968 - Aug. 1969
Edward L. Jeter Jun. 1971 71 p refs
(AD-728753; NWC-TP-5182) Avail: NTIS CSCL 21/9

A numerical integration procedure is developed to solve a general axisymmetric plane strain cylinder problem involving thermorheologically simple viscoelastic material properties. Axisymmetric loadings due to internal pressure, centrifugal body forces, and thermal stresses are considered in the analysis, and use is made of the Moreland-Lee reduced time hypothesis in order to include the ability to solve problems undergoing transient temperature distributions. Provisions are also included for solving the problem of a viscoelastic cylinder with an elastic case. Several check solutions are compared with some exact results and known solutions, and a solution is given for solid rocket propellant grain during firing when the inside surface is ablating. Realistic solid propellant material properties are employed in the latter solution. Author (GRA)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N72-12779*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPERATIONAL PROCEDURE FOR COMPUTER PROGRAM FOR DESIGN POINT CHARACTERISTICS OF A COMPRESSED-AIR GENERATOR WITH THROUGH-FLOW COMBUSTOR FOR V/STOL APPLICATIONS
Richard P. Krebs Washington Nov. 1971 36 p refs
(NASA-TM-X-2422; E-6563) Avail: NTIS CSCL 21E

The computer program described in this report calculates the design-point characteristics of a compressed-air generator for use in V/STOL applications such as systems with a tip-turbine-driven lift fan. The program computes the dimensions and mass, as well as the thermodynamic performance of a model air generator configuration which involves a straight through-flow combustor. Physical and thermodynamic characteristics of the air generator components are also given. The program was written in FORTRAN IV language. Provision has been made so that the program will accept input values in either SI units or U.S. customary units. Each air generator design-point calculation requires about 1.5 seconds of 7094 computer time for execution. Author

N72-12780*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DETERMINATION OF NORMAL-SHOCK POSITION IN A MIXED COMPRESSION SUPERSONIC INLET
Miles O. Dustin, Gary L. Cole, and Robert E. Wallhagen Washington Nov. 1971 20 p refs
(NASA-TM-X-2397; E-6373) Avail: NTIS CSCL 20D

Methods of determining inlet normal shock position from wall static pressure profiles were investigated. By using methods investigated in this report, it should be possible to control an inlet with less stability margin. Variation in inlet angle-of-attack caused drastic changes in pressure profile shape and wide variations in the angle of the shock plane with respect to the inlet axis. Thus, four sensors located around the circumference may be required to handle angle-of-attack and sideslip variations. One criterion would determine the shock position by comparing individual statics to a properly selected reference pressure. Author

N72-12781*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A NEUTRALIZER FOR ELECTRON BOMBARDMENT THRUSTER
Robert T. Bechtel [1971] 13 p refs Proposed for presentation at the 10th Aerospace Sci. Meeting, San Diego, 17-19 Jan. 1972; sponsored by AIAA
(NASA-TM-X-67964; E-6677) Avail: NTIS CSCL 21C

Results of the SERT II flight indicate that the hollow cathode neutralizer not only represents a power and propellant weight penalty but can be a contributing cause to accelerator grid erosion. Tests with a 30-cm diameter thruster show that a neutralizer position of approximately 9 cm axially downstream of the accelerator grid and approximately 9 cm radially away from the outer edge of the accelerator grid and pointing parallel to the thruster axis provides the best overall performance. The estimated grid wear rate was less than 0.08 mm in 10,000 hours. The coupling voltage was approximately 17 volts at a neutralizer flow rate of 22 equivalent milliamperes of mercury and a beam current of 1.5 amperes. Neutralizer power was 31 watts and the effect of neutralizer flow on overall propellant utilization efficiency is a 1.2 percentage point reduction at a thruster utilization efficiency of 90 percent. The neutralizer position defined in tests with a 30 cm thruster was tested with a 15 cm SERT II thruster. When the neutralizer was relocated further downstream with this different orientation, accelerator impingement current due to neutralizer operation was reduced by approximately a factor of seven and was nearly independent of neutralizer operation. Author

N72-12782*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TEMPORAL SURVEY OF ELECTRON NUMBER DENSITY AND ELECTRON TEMPERATURE IN THE EXHAUST OF A MEGAWATT MPD-ARC THRUSTER
Charles J. Michels, James R. Rose, and Donald R. Sigman [1971] 7 p refs Proposed for presentation at the 10th Aerospace Sci. Meeting, San Diego, Calif., 17-19 Jan. 1972; sponsored by AIAA
(NASA-TM-X-67971) Avail: NTIS CSCL 21C

Temporal and radial profiles are obtained 30 cm downstream from the anode for two peak arc currents (11.2 kA and 20 kA) and for various auxiliary magnetic fields (0, 1.0 T, and 2.0T) using the Thomson scattering technique. Average density and temperature are relatively constant for over 100 microseconds with significant fluctuations. Radial profiles obtained are relatively flat for 4 cm from the axis. Compared to earlier 20 cm data, the exhaust density has decreased significantly, the average temperature (4.6 eV) has not changed, and the density hole with an auxiliary magnetic field has enlarged. Author

N72-12783*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUPERSONIC TURBINE DESIGN AND PERFORMANCE
Louise J. Goldman [1971] 13 p refs Proposed for presentation at Joint Conf. of the Gas Turbine Div. and the Fluids Eng. Div., San Francisco, 26-30 Mar. 1962; sponsored by ASME
(NASA-TM-X-67961; E-6671) Avail: NTIS CSCL 21E

Methods for designing supersonic stator and rotor blading corrected for boundary layer displacement thickness are summarized. Computer programs based on these methods have been reported in NASA publications. Analytical blade losses for blading of this type are presented and design limitations resulting from consideration of flow separation and supersonic starting are discussed. In addition, a summary of the experimental performance of a single-stage turbine designed by these methods is given. Author

N72-12784*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RECENT RADIAL TURBINE RESEARCH AT THE NASA LEWIS RESEARCH CENTER
Harold E. Rohlik and Milton G. Kofskey [1971] 13 p refs Proposed for presentation at Gas Turbine Power and Fluids Eng. Div. Conf., San Francisco, 26-30 Mar. 1972; sponsored by ASME
(NASA-TM-X-67903; E-6516) Avail: NTIS CSCL 21E

The high efficiencies of small radial turbines led to their application in space power systems and numerous APU and shaft power engines. Experimental and analytical work associated with these systems included examination of blade-shroud clearance, blade loading, and exit diffuser design. Results indicate high efficiency over a wide range of specific speed and also insensitivity to clearance and blade loading in the radial part of the rotor. The exit diffuser investigation indicated that a conventional conical outer wall may not provide the velocity variation consistent with minimum overall diffuser loss. Author

N72-12785*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EMPIRICAL EXPRESSIONS FOR ESTIMATING LENGTH AND WEIGHT OF AXIAL-FLOW COMPONENTS OF VTOL POWERPLANTS
David A. Sagerser, Seymour Lieblein, and Richard P. Krebs Washington Dec. 1971 39 p refs
(NASA-TM-X-2406; E-6191) Avail: NTIS CSCL 21E

Simplified equations are presented for estimating the length and weight of major powerplant components of VTOL aircraft. The equations were developed from correlations of lift and cruise engine data. Components involved include fan, fan duct, compressor, combustor, turbine, structure, and accessories. Comparisons of actual and calculated total engine weights are included for several representative engines. Author

N72-12786*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ION-THRUSTER PROPELLANT UTILIZATION
Harold R. Kaufman Washington Dec. 1971 57 p refs
(NASA-TN-D-6591; E-6219) Avail: NTIS CSCL 21C

The evaluation and understanding of maximum propellant utilization, with mercury used as the propellant are presented.

The primary-electron region in the ion chamber of a bombardment thruster is analyzed at maximum utilization. The results of this analysis, as well as experimental data from a range of ion-chamber configurations, show a nearly constant loss rate for unionized propellant at maximum utilization over a wide range of total propellant flow rate. The discharge loss level of 1000 eV/ion was used as a definition of maximum utilization, but the exact level of this definition has no effect on the qualitative results and little effect on the quantitative results. There are obvious design applications for the results of this investigation, but the results are particularly significant whenever efficient throttled operation is required. Author

N72-12787# Grumman Aerospace Corp., Bethpage, N.Y. Fluid Dynamics Section.
ON THE SIMULATION OF PLUMES FROM HIGH PRESSURE HYDROGEN/OXYGEN ROCKET ENGINES
H. Hopkins, J. Leng, R. Oman, and W. Konopka Nov. 1971 27 p refs
(RM-524) Avail: NTIS

A description is given of the technique used to obtain Reynolds numbers higher than those achievable by any other known technique, and an outline is given of the experiments which can be used to increase the confidence level when extrapolating sub-scale plume impingement heating to full scale flight conditions is given. Initial experiments established the feasibility of using a backward-running detonation wave to produce the correct enthalpy and chemistry of the simulated combustion chamber gases. Low pressure tests (up to 1500 psi) are summarized which measured heating on simulated impingement surfaces from one and two engines. Facility modifications to allow safe handling of the hydrogen and oxygen to produce chamber pressures up to 20,000 psi are also described. Author

N72-12788*# IIT Research Inst., Chicago, Ill.
MARS SURFACE SAMPLE RETURN MISSIONS VIA SOLAR ELECTRIC PROPULSION
D. J. Spadoni and A. L. Friedlander Aug. 1971 75 p refs
(Contract NAS7-100; JPL-952701; Task Order-RD-26)
(NASA-CR-124638; T-29) Avail: NTIS CSCL 21C

The characteristics and capabilities are described of solar electric propulsion (SEP) for performing Mars Surface Sample Return (MSSR) missions. The scope of the study emphasizes trajectory/payload analysis and the comparison of mission/system tradeoff options. The MSSR mission is examined only for the 1981-82 launch opportunity. Several other study constraints which bear directly on the results obtained are: (1) return samples in the range 5-25 kg, (2) use of lifting (offset C.G.) atmospheric entry at Mars which allows a low ratio (1.25) of entry weight to landed weight, and (3) rendezvous and docking in Mars orbit. Major results of the study are presented as performance curves of earth departure mass versus sample size for a number of different mission/system options. These options represent a spectrum of trip time, launch vehicle capability, combinations of low-thrust and ballistic maneuvers, chemical retro type, and earth recovery mode. Author

N72-12789*# Martin Marietta Corp., Denver, Colo. Structures and Materials.
BORON EPOXY ROCKET MOTOR CASE PROGRAM Final Report
D. A. Stang Sep. 1971 63 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952841)
(NASA-CR-124632; MCR-71-223) Avail: NTIS CSCL 21H

Three 28-inch-diameter solid rocket motor cases were fabricated using 1/8 inch wide boron/epoxy tape. The cases had unequal end closures (4-1/8-inch-diameter forward flanges and 13-inch-diameter aft flanges) and metal attachment skirts. The flanges and skirts were titanium 6Al-4V alloy. The original design for the first case was patterned after the requirements of the Applications Technology Satellite apogee kick motor. The second and third cases were designed and fabricated to approximate the requirements of a small Applications Technology Satellite apogee kick motor. The program demonstrated the feasibility of designing and fabricating large-scale filament-wound solid propellant rocket motor cases with boron/epoxy tape. Author

N72-12790*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FIELD EVAPORATION ION SOURCE WITH POSSIBLE APPLICATION TO ELECTROSTATIC PROPULSION
Victor G. Weizer Washington Dec. 1971 20 p refs
(NASA-TN-D-6593; E-6540) Avail: NTIS CSCL 21C

Field evaporation of solid metal electrodes has been proposed as an ion source for an electrostatic propulsion device. The chief advantage over existing ion sources is the prospect of 100 percent fuel utilization efficiency. This advantage arises as a result of the elimination of the need for a gaseous precursor state for propellant ionization. The attainment of required high surface field strengths is achieved through field-induced extrusion of the electrode geometry at elevated temperatures. Contributions of both surface and bulk transport mechanisms are taken into account. Author

N72-12791*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LOW ACCELERATION SOLID PROPELLANT ROCKET IGNITION STUDY
Leon D. Strand 1 Dec. 1971 36 p refs
(Contract NAS7-100)
(NASA-CR-124574; JPL-TM-33-506) Avail: NTIS CSCL 21H

A study was conducted to develop a solid-propellant rocket igniter system that would build up thrust at a controlled rate of less than 0.2 G/sec. The system consisted of a long burning, regressive burning, controlled flow igniter and an inhibited progressive burning surface in the main rocket motor. The igniter performed the dual role of igniting, under vacuum backpressure and low L* (motor free volume/nozzle throat area ratio) conditions, the nonrestricted portion of the propellant and providing the mass addition necessary to sustain combustion until the propellant burning area had increased sufficiently to provide a stable motor-chamber pressure. Two series of tests were conducted with existing small test motor hardware to: (1) demonstrate the feasibility of the concept, (2) determine the important parameters governing the system, and (3) obtain design guidelines for future scaled-up motor tests. A quasi-steady-state mass balance for the ignition system was written and programmed for use as a motor design tool. Author

N72-12792*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLAR ELECTRIC PROPULSION SYSTEM TECHNOLOGY
T. D. Masek and T. W. Macie 15 Nov. 1971 29 p refs
(Contract NAS7-100)
(NASA-CR-124572; JPL-TM-33-510) Avail: NTIS CSCL 21C

Achievements in the solar electric propulsion system technology program (SEPST 3) are reported and certain propulsion system-spacecraft interaction problems are discussed. The basic solar electric propulsion system concept and elements are reviewed. Hardware is discussed only briefly, relying on detailed fabrication or assembly descriptions reported elsewhere. Emphasis is placed on recent performance data, which are presented to show the relationship between spacecraft requirements and present technology. Author

N72-12793*# Hughes Research Labs., Malibu, Calif.
DESIGN AND DEVELOPMENT OF A SMALL STRUCTURALLY INTEGRATED ION THRUSTER SYSTEM
Julius Hyman, Jr. Oct. 1971 145 p refs
(Contract NAS3-14129)
(NASA-CR-120821) Avail: NTIS CSCL 21H

A 5 cm structurally integrated ion thruster has been developed for attitude control and stationkeeping of synchronous satellites. With 2-D vectorable grids, thrust is 0.56 mlb at a

beam voltage of 1200 V, total mass efficiency is 64%, and electrical efficiency is 46.8%. Nonvectoring thrust of 0.41 is demonstrated at very low specific impulse with dielectric coated grids. Structural integrity is demonstrated with dielectric coated grids for shock (30 G), sinusoidal (9 G), and random (19 G squared/Hz) accelerations. System envelope is 31.6 cm long by 14 cm flange B.C. with a mass of 8.5 kg including 6.2 Kg mercury propellant. Author

N72-12794# Societe Europeenne de Propulsion, Bordeaux (France).
ATTITUDE CONTROL OF SPACE VEHICLES USING AUXILIARY PROPULSION ENGINES PART 1: COMPARATIVE STUDY OF VARIOUS SYSTEMS [CONTROLE D'ATTITUDE DES VEHICULES SPATIAUX AU MOYEN DE MOTEURS DE PROPULSION AUXILIAIRE. LOT 1: ETUDE COMPARATIVE DE DIFFERENTS SYSTEMES]
M. Moravie Paris ESRO Jan. 1971 59 p In FRENCH: ENGLISH summary
(Contract ESTEC-734/69)
(ESRO-CR-27) Avail: NTIS

The various possible ways are analyzed and compared for compensating disturbance torques by controlling the thrust vector of the auxiliary propulsion thrustors (secondary injection of gas or liquid, jet deflection vanes, gimballed thrustors, control laws). It is concluded that (low thrust motors of 5 to 30 N), gimballed thrustors are preferable for attitude control.
Author (ESRO)

N72-12795# Curtiss-Wright Corp., Wood-Ridge, N.J.
SINGLE-STAGE AXIAL COMPRESSOR STATOR REDESIGN INVESTIGATION Final Report
C. Muller Ft. Eustis, Va. Army Aviation Materiel Labs. Oct. 1970 98 p refs
(Contract DAAJ02-69-C-0085)
(AD-877209; USAAVLABS-TR-70-56; CW-WR-69-072.F; Task-1C162203D14413) Avail: NTIS CSCL 21/5

A program is described to redesign the exit stators of a 2.8:1 pressure ratio supersonic axial compressor, and to fabricate and test the redesigned stators to evaluate the effect of the redesign on the overall stage performance. This compressor is intended to serve as a boost stage in axial centrifugal compressors with overall pressure ratios of 16.1 for small gas turbine engines. The redesign was undertaken to provide an essentially cylindrical flow path aft of the rotor. The measured performance showed no improvement over the original design, and indicated a two-point degradation in efficiency. Author (GRA)

N72-12796# Pratt and Whitney Aircraft, West Palm Beach, Fla.
TURBINE BLADE/DISK FABRICATION INVESTIGATION Final Report
George W. Kelch and Richard W. Nelson Ft. Eustis, Va. Army Aviation Materiel Labs. Sep. 1970 176 p refs
(Contract DAAJ02-68-C-0071)
(AD-877170; USAAVLABS-TR-70-53; PWA-FR-3827; Task-1G162203D14413) Avail: NTIS CSCL 21/5

An investigation of blade/disk attachment methods for small gas turbine engines is reported. The investigation included analytical and experimental evaluations of selected attachment methods potentially suitable for a 2 lb/sec axial flow turbine with 2500 F turbine inlet temperature. A literature survey of attachments for small axial flow turbines yielded six candidate methods for further analytical study. The three most promising approaches were evaluated experimentally to determine the superior attachment technique. Author (GRA)

N72-12797# Rocket Propulsion Establishment, Westcott (England).
TWO-STAGE (RESISTOJET ION MOTOR) TRANSFER OF COMMUNICATIONS SATELLITES
W. T. Lord and R. C. Parkinson Aug. 1970 33 p refs Presented at the AIAA 8th Elec. Propulsion Conf., Stanford, Calif., 31 Aug. - 2 Sep. 1970
(RPE-TR-70/11) Avail: NTIS

Thruster exhaust velocities between 9 and 18 km/sec are shown to be attractive for transferring communications satellites to synchronous orbit. No available thruster has an exhaust velocity in this range, but two-stage transfer using hydrogen resistojets (velocities less than 9 km/sec) and mercury ion motors (velocities greater than 18 km/sec) could provide equivalent performance, the equivalent exhaust velocity being related to the altitude of the orbit of switchover from resistojets to ion motors. Moreover, the equivalent efficiencies obtained could be quite high. In particular, it is shown that a resistojet/ion motor system combined with a thrust-augmented Delta launch vehicle could transfer a 583 kg 10 kW satellite to synchronous orbit in two and a half months. Author (ESRO)

N72-12798# Cincinnati Univ., Ohio.
SIMULATION OF ENVIRONMENTAL SOLID-PARTICLES TRAJECTORIES AND VELOCITIES THROUGH AN AXIAL FLOW COMPRESSOR STAGE, AND THE PRESSURE DISTRIBUTION ON BLADES
W. Tabakoff, A. Hamed, and M. F. Hussein 1971 34 p refs Presented at 10th Natl. Conf. on Environ. Effects on Aircraft and Propulsion Systems, Trenton, 18-20 May 1971
(Contract DAHC04-69-C-0016; DA Proj. 2T0-14501-B-81-B)
(AD-725596; AROD-T-4-31-E; Rept-71-5) Avail: NTIS CSCL 13/7

An experimental investigation is reported of the trajectories and velocities of solid particles suspended in a fluid passing through an axial flow compressor stage. Such investigation is of importance to the study of erosion damage sustained by the blade. Two test facilities were used for this study: a subsonic cascade wind tunnel for compressible flow and a water table for incompressible flow. From the test technique it would appear that the present existing theoretical analysis for particle trajectories through a compressor stage is questionable. The wind tunnel test simulation is preferred for predicting particle trajectories.
Author (GRA)

N72-12799# Minnesota Univ., Minneapolis. Heat Transfer Lab.
FLOW AND HEAT TRANSFER IN A ROTATING ENCLOSURE WITH AXIAL THROUGHFLOW
Dietmar K. Hennecke, Ephraim M. Sparrow, and Ernest R. G. Eckert 1 May 1971 67 p refs
(Contract N00014-68-A-0141-0001; Themis Proj. 108)
(AD-725852; HTL-99) Avail: NTIS CSCL 21/5

An analysis is made of the fluid flow and heat transfer processes in a circular cylindrical enclosure rotating about its own axis. A coolant is passed through the enclosure, entering and leaving through centrally located apertures in the end walls. This configuration is intended as a model of rotating enclosures in devices such as gas turbines and air compressors. The Navier-Stokes and energy equations are solved by a finite-difference formulation which can accommodate either steady or transient conditions. Buoyancy forces associated with the rotational body forces are included in some cases. All solutions have been performed for laminar flow. The coolant flow is confined to a corridor adjacent to the axis of the enclosure, and there is no mixing between the coolant and the fluid in the enclosure proper. Author (GRA)

N72-12800# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VIBRATION AND OSCILLATION OF AVIATION ENGINE ROTORS
M. E. Levit and V. P. Roizman 14 Jun. 1971 239 p refs Transl. into ENGLISH of the book "Vibratsiya i Uravnoveshivanie Rotorov Aviadvigatelei" Moscow, Izd-vo Mashinostroyeniye, 1970 p 1-172
(AF Proj. 604010)
(AD-728121; FTD-MT-24-6-71; DIA-Task-T65-04-18A; UR/0000-70-000-000) Avail: NTIS CSCL 21/5

The book represents a survey of the contemporary methods

of balancing the rotors of aircraft engines and lists the factors which influence the level of vibrations of engines. It is noted that one of the basic reasons for vibrations is the imbalance of elastically deformable rotors during operation at rpm's close to critical. Simplified methods of balancing are given, producing a considerable effect when using equipment existing in plants. Much attention is given to the complex method of the research of the dynamics of aircraft engines such as the stage preceding the selection of the means of rotor balancing. The results of research on vibrations of full scale gas-turbine aircraft engines and of their compressors and turbines are illuminated. Given is a fundamental solution of the questions connected with automation of the processes of balancing and development of new means of balancing; apparatus and equipment have been described. Basic problems in the area of the further development of the theory and practical methods of balancing of rotary systems of aircraft engines have been formulated. Author (GRA)

N72-12801# Naval Weapons Center, China Lake, Calif.
LONGITUDINAL MODE ACOUSTIC LOSSES IN SHORT NOZZLES
Ben T. Zinn Aug. 1971 24 p refs
(AF Proj. 3059-70-4)
(AD-728754; NWC-TP-5206) Avail: NTIS CSCL 21/8

The report is a professional treatise concerning acoustic damping by a 'short nozzle'. It is for the most part not original but is written in such a manner that it can be read by an engineer without need to resort to the plethora of more sophisticated analyses available in the literature. Author (GRA)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N72-12802*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LONG TERM TEMPORAL VARIATIONS OF THE HARD X-RAY FLUX FROM THE CENTAURUS REGION
Daniel A. Schwartz, Laurence E. Peterson (Calif. Univ., San Diego), and Hugh S. Hudson (Calif. Univ., San Diego) Nov. 1971 17 p refs
(NASA-TM-X-65761; X-661-71-445) Avail: NTIS CSCL 03B

The X-ray telescope aboard the third Orbiting Solar Observatory (OSO-3) observed the Centaurus region daily from 1967 October to 1968 February, and also for five days in 1968 June. A stable minimum flux of 0.33 + or - 0.03 photons (sq cm sec)/1 between 7.7 and 38 keV from a source around I = 305 deg is derived. Several single days show enhanced fluxes, and two extensive flaring episodes, one with a soft and the other a very hard spectrum, lasting at least ten days. Author

N72-12803# Lockheed Missiles and Space Co., Palo Alto, Calif.
MEASUREMENT OF FLUXES OF HIGH ENERGY GAMMA QUANTA IN PRIMARY COSMIC RADIATION ON THE KOSMOS-208
L. S. Bratoliubova-Tsulukidze, N. L. Grigorov, L. F. Kalinkin, A. S. Melioranskii, E. A. Priahkin, I. A. Savenko, and V. Ia. Iufarkin [1971] 6 p refs Transl. into ENGLISH from Geomagn. Aeron. (USSR), v. 11, no. 4, 1971 p 585-589
Avail: NTIS; National Translation Center, John Crerar Library, Chicago, Ill. 60616

The intensity of gamma quanta with E sub gamma > or = 30 MeV energies was measured on the Cosmos 208 satellite. Similar dependences of the counting rates of gamma quanta and charged particles on the geomagnetic latitude were observed. Author

N72-12804*# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
ELECTROSTATIC, SHORT-WAVELENGTH, TURBULENCE AS THE SOURCE OF ION HEATING IN THE SOLAR WIND
Konstantinos Papadopoulis (NRL) [1971] 19 p refs
(Grant NGL-21-002-005)
(NASA-CR-123477) Avail: NTIS CSCL 03B

A mechanism is proposed for the nonthermal ion heating observed in the solar wind at 1 A.U. based on an electrostatic, short wavelength, instability between the ions in the observed colliding plasma streams. The modes lying on a plane perpendicular to the magnetic field thermalize most of the differential energy. The model suggests local electrostatic turbulence, that alpha-particles are heated more than protons, a maximum proton temperature T sub P < 1 million k, and for the bulk speed U possibly a sq root of T sub P = aU + b relationship. These predictions are consistent with observations. Author

N72-12805*# Translation Consultants, Ltd., Arlington, Va.
ONE POSSIBILITY OF SEARCHING FOR QUARKS IN EXTENSIVE AIR SHOWERS OF COSMIC RAYS
V. D. Volovik and A. D. Ivanov Dec. 1971 6 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk), no. 9, (112), 1971 p 121-123
(Contract NASw-2038)
(NASA-TT-F-14082) Avail: NTIS CSCL 04A

Efforts already made to find the fundamental triplet in the free state are described. It is suggested that lag time for quarks may contain the components for finding the fundamental triplet. Great interest is expressed in investigating the time distribution of extensive air shower components in the cores of horizontal showers. Author

N72-12806*# Scientific Translation Service, Santa Barbara, Calif.
COSMOLOGY AND HIGH ENERGY PARTICLES
I. L. Rozental Washington NASA Aug. 1971 149 p refs Trans. into ENGLISH of Acad. of Sci. /USSR/, Moscow. Inst. for Space Res. report Pr-0002, 1969 p 1-54
(Contract NASw-2035)
(NASA-TT-F-13723; Pr-0002) Avail: NTIS CSCL 03B

The prospects and results of using cosmic high energy particles (nuclei, photons, and electrons) to determine cosmological parameters are considered. The parameters are average density of matter, evolution of radiation sources, and temperatures of intergalactic media. The processes of the penetration of cosmic particles into the universe are considered in detail. The origin of electron components of cosmic rays is analyzed. Author

N72-12807*# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.
SOLAR ACTIVITY PREDICTION
Ralph J. Slutz, Thomas B. Gray, Marie L. West, Frank G. Stewart, and Margo Leftin Washington NASA Nov. 1971 114 p refs
(NASA Order H-54409A)
(NASA-CR-1939) Avail: NTIS CSCL 03B

A statistical study of formulas for predicting the sunspot number several years in advance is reported. By using a data lineup with cycle maxima coinciding, and by using multiple and nonlinear predictors, a new formula which gives better error estimates than former formulas derived from the work of McNish and Lincoln is obtained. A statistical analysis is conducted to determine which of several mathematical expressions best describes the relationship between 10.7 cm solar flux and Zurich sunspot numbers. Attention is given to the autocorrelation of the observations, and confidence intervals for the derived relationships are presented. The accuracy of predicting a value of 10.7 cm solar flux from a predicted sunspot number is dicussed. Author

N72-12808# Smithsonian Astrophysical Observatory, Cambridge, Mass.
EXTENSIVE AIR SHOWER STUDIES OF COSMIC GAMMA RAYS AND COSMIC RAY COMPOSITION Ph.D. Thesis - Harvard Univ.
Jonathan Ellis Grindlay 28 May 1971 156 p refs
(SAO-Special-Rept-334) Avail: NTIS

Calculations for the Compton-synchrotron spectrum of gamma rays produced in the Crab nebula were performed using the exact Compton scattering formalism, an assumed radial variation (1/r) of the nebular magnetic field due to the pulsar, and the measured radial variation of the optical intensity. A relatively higher yield of gamma rays near approximately 10 to the 12th power eV was found than in previous calculations assuming homogeneity. In an effort to detect such gamma-rays by the detection of the extensive air showers (EAS) they would contribute to the background of cosmic ray-initiated showers, previous EAS studies were reviewed to determine the possibility of identification of the primary particle initiating and individual EAS. The muon component and longitudinal development were found to be most important. Numerous experimental observations of EAS were then conducted to ascertain whether these effects could be observable in the detailed structure of the Cerenkov light produced in EAS. Strong evidence is presented for the existence of a unique component of the Cerenkov radiation from the penetrating shower cores, tentatively identified as the muon component. A three-dimensional Monte Carlo calculation of EAS initiated by protons confirmed this hypothesis. Author

N72-12809# Joint Publications Research Service, Washington, D.C.
ATMOSPHERE SOUNDING DURING HIGH SOLAR ACTIVITY
6 Dec. 1971 13 p refs Transl. into ENGLISH from Issled. Atmosfery Ionosfery v Period Povyshennoy Soln. Aktivnosti (USSR), Mar. - Apr. 1969 p 15-30
(JPRS-54621) Avail: NTIS

Measurements were carried out on an electron stream in the atmosphere at altitudes of 97-160 km. The following characteristics of the corpuscular stream in the atmosphere were obtained from 18 to 21 April: (1) a total energy flux of electrons with E greater than or equal to 3 Kev was measured. (2) parameters of the energy spectrum of the electrons were determined; (3) time variations of the electron stream and anisotropy were observed; a strong absorption at altitudes h smaller than 100 km was noted; and (4) a strong gassing of the rocket head was observed. The obtained values of the electron streams and their day-to-day changes reflect on the ionization of the lower part of the E region of the ionosphere at altitudes of about 100 km. Author

N72-12810*# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.
INTERACTION OF COSMIC RAYS WITH INTERSTELLAR MATTER AND POSSIBLE EXCITATION OF X-RAY LINES
Satya Dev Verma [1971] 5 p refs
(Grant NGR-19-001-012)
(NASA-CR-124580; OG-9) Avail: NTIS CSCL 04A

It is proposed that the excess diffuse cosmic X-rays in the fractional keV energy band are produced as a result of excitation of neutral carbon, sulphur, and argon atoms by cosmic rays, with subsequent emission of the K X-rays of carbon and the L X-rays of sulphur and argon. It is suggested that if the intensities of low energy cosmic rays, and the cross sections for the production of X-ray lines were known, the observations of X-ray lines could provide k direct information concerning abundances of elements in the interstellar regions. Author

N72-12811*# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.
AN EXPERIMENT TO STUDY THE NUCLEAR COMPONENT OF PRIMARY COSMIC RAYS
J. M. Paul and S. D. Verma [1971] 6 p refs Sponsored in part by Res. Corp.
(Grant NGR-19-001-012)
(NASA-CR-124578; TECH-29) Avail: NTIS CSCL 04A

An apparatus has been designed and is being fabricated to study the charge composition, fluxes, and energy spectra of light nuclei in the energy region from 1 GeV to 100 GeV. The apparatus essentially consists of an array of a large number of particle detectors operated in coincidence and serving as a charged particle telescope. A mosaic silicon semiconductor detector, a plastic scintillation counter and a lucite Cerenkov detector are used to measure the charges of the incident nuclei. Two one-inch thick CsI detectors are used to study low energy particles. An ionization spectrometer is utilized to measure primary energies in the 1 to 100 GeV energy interval. A gas Cerenkov counter is being designed to distinguish between electrons and protons. It is planned to calibrate the apparatus at an accelerator using particles of known energy. Author

N72-12812# Los Alamos Scientific Lab., N.Mex.
RESULTS OF POLARIZATION OBSERVATIONS OF THE OUTER CORONA FROM A JET AIRCRAFT
C. F. Keller Jun. 1971 11 p refs Presented at the 14th COSPAR Meeting, Seattle, 17 Jun. 1971 Sponsored by AEC
(LA-DC-12495; Conf-710615-1) Avail: NTIS

Observations were made from an NC-135 aircraft at 36,380 ft over the Gulf of Mexico just off the coast of Mexico. White-light photographs were taken from a stabilized camera; four each were made for six exposure times ranging from 1.0 to 10.0 seconds; three each were made through plane Polaroid filters whose orientation was varied at 60 deg intervals. One streamer was recorded at 13 solar radii and six others could be seen beyond 7 solar radii. NSA

N72-12813# Academy of Sciences (USSR), Moscow. Inst. for space research.
OBSERVATIONS OF COMPACT RADIO SOURCES USING RADIOINTERFEROMETERS WITH GREEN BANK-CRIMEA AS A BASE LINE
J. J. Broderick, B. G. Clar, M. H. Cohen, V. A. Ephanov, and B. Hansen 1970 21 p In RUSSIAN and ENGLISH
(PR-29) Avail: NTIS

The first results of size measurements of compact radio sources which were determined at 6 and 2.8 cm wavelengths using radio interferometers. An independent signal registration with Green Bank-Crimea base line are presented. Author (ESRO)

N72-12814# Academy of Sciences (USSR), Moscow. Inst. for Space Research
RADIATION IN THE UNIVERSE AND COSMIC ELECTRONS
O. F. Prilutskii 1970 37 p refs
(PR-22) Avail: NTIS

Possible sources of background radiation which may be integrated radiation from the metagalaxy are investigated. Two theories are analyzed. One, termed dual, stems from the assumption that the soft (radio) part of the background radiation is caused by the synchrotron radiation, while the X radiation is caused by the inverse Compton effect. The other, the synchrotron theory, presumes that the background radiation is of synchrotron origin. Within the framework of these theories, it is concluded that the basic contribution to the background radiation is made by distant galaxies, with z greater than or equal to two. However, in the dual theory, the normal galaxies effect, and in the synchrotron theory that of powerful radio galaxies and quasars, are believed prevalent. The intergalactic gas ionization by ultraviolet radiation in the metagalaxy is studied, using both theories. The weak points of both theories are analyzed, and test methods are described. Author (ESRO)

N72-12815# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
ON DIURNAL VARIATIONS AND VARIATIONS WITH SOLAR ACTIVITY OF TEMPERATURE IN THE THERMO-

SPHERE
M. N. Izakov and I. A. Jascenko 1971 28 p refs In ENGLISH and RUSSIAN
(D-101) Avail: NTIS

The available data on the thermosphere temperature is summarized, and the characteristics of its diurnal and solar activity variations are evaluated. It was found that the amplitude of diurnal temperature variations is practically independent of solar activity and is characterized by seasonal latitudinal variations. ESRO

N72-12816# Aerospace Corp., El Segundo, Calif.
OBSERVATIONS OF PRECIPITATING PROTONS IN THE ENERGY RANGE 2.5 KeV LESS THAN OR EQUAL TO E LESS THAN OR EQUAL TO 200 KeV
J. M. Cornwall, Henry H. Hilton, and Paul F. Mizera 15 Jul. 1971 51 p refs
(Contract F04701-71-C-0172)
(AD-728207; SAMSO-TR-71-145; TR-0172(2260-20)-6) Avail: NTIS CSCL 04/1

Measurements of precipitating protons in the energy range 2.5 - 200 keV have been made on Ov1-15 (1968-59A), a low-altitude polar satellite, with a combination of electrostatic analyzers and integral foil detectors. During disturbed times, precipitating proton fluxes in the range 10 million - 100 million/sq cm-sec are seen. On several occasions, it has been possible to compare the spatial distribution of precipitation with the plasmapause profile taken by Ogo 5 during all phases of magnetic storm activity. It is found that the near-earth boundary of maximum proton precipitation lies just inside the plasmapause. If observed pitch-angle distributions are classified according to whether the loss cone is nearly empty or otherwise, it is found that the corresponding 40 keV flux intensities and L values separate into two classes in a way described by weak vs strong pitch-angle diffusion. Author (GRA)

N72-12179# Joint Publications Research Service, Washington, D.C.
COSMIC RAY RESEARCH
S. N. Vernov, G. P. Lyubimov, Ye. A. Chuchkov, and N. N. Kontor *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 175-189 refs (See N72-12168 03-11)
Avail: NTIS

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N72-12817*# National Research Corp., Cambridge, Mass.
LUNAR MASS SPECTROMETER TEST PROGRAM Final Report
F. L. Torney and J. R. Dobrott [1971] 89 p refs
(Contract NASw-2114)
(NASA-CR-124611) Avail: NTIS CSCL 03B

The procedures used and the results are described, which were obtained in a test program to demonstrate the performance of a candidate lunar mass spectrometer. The instrument was designed to sample and measure gases believed to exist in the lunar atmosphere at the surface. The instrument consists of a cold cathode ion source, a small quadrupole mass analyzer, and an off-axis electron multiplier ion-counting detector. Instrument resolution, sensitivity, and S/N ratio were demonstrated over the mass range 0-150 amu and over a partial pressure range from ntorr to ptorr. The subject analyzer was also prepared for extended testing, in conjunction with two other candidate instruments, in a large molecular beam vacuum facility. Author

N72-12818*# Hawaii Univ., Honolulu. Inst. for Astronomy.
A SEARCH FOR N-TYPE GALAXIES Final Status Report
John T. Jefferies 6 Oct. 1971 6 p refs
(Grant NGR-12-001-070)
(NASA-CR-124841) Avail: NTIS CSCL 03A

A large number of distant clusters of galaxies was examined for the presence of a bright compact galaxy or blue stellar object. Nearly 600 square degrees of sky were searched using glass copies of the National Geographic Society-Palomar Observatory Sky Survey plates, and over 20 fields were selected for observation. The objects were examined for infrared and ultraviolet excesses, using wideband filter photography and spectroscopy. Initial findings include a faint, distant cluster of galaxies near the quasi-stellar radio source 4C 37.43 with a red shift of 0.370. One of these galaxies has an emission line at 6895 A, indicating a possible red shift of 0.377 of the 5007 A line of (O III). N.E.N.

N72-12819# North American Rockwell Corp., Downey, Calif. Space Div.
SPACE PROGRAM BENEFITS
17 Apr. 1968 44 p
(SD-68-368) Avail: NTIS

Some of the technological achievements that have resulted from Project Apollo are briefly described. These achievements are expected to directly benefit not only the aerospace industry but also other industries and the entire economy and welfare of the country. Author

N72-12820# National Research Council of Canada, Ottawa (Ontario).
DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT Quarterly Bulletin
30 Sep. 1971 94 p refs
(DME/NAE-1971(3)) Avail: NTIS

Projects conducted by the Mechanical Engineering and National Aeronautical Establishment of Canada are discussed. Three topics concerning water pollution, an electric heater, and lubrication under cold weather conditions are presented in detail. Research projects are briefly described which encompass the following subjects: (1) industrial control problems, (2) human factors engineering, (3) ducted fan aerodynamics, (4) locomotive Diesel engines, (5) aircraft instruments, (6) atmospheric turbulence, (7) V/STOL propulsion, (8) gas dynamics, and (9) low speed aerodynamics. Author

N72-12821*# California Univ., Los Angeles. Dept. of Planetary and Space Science.
HIGH FREQUENCY ELECTROMAGNETIC RESPONSE OF THE MOON
G. Schubert and K. Schwartz (Am. Nucleonics Corp., Woodland Hills, Calif.) Nov. 1971 28 p refs
(Contract NAS2-5876)
(NASA-CR-114385) Avail: NTIS CSCL 03B

It is shown that the contribution of higher harmonics to the lunar transfer functions for the tangential components of the surface magnetic field is significant at frequencies greater than 0.01 Hz. The inclusion of the higher harmonics shows that there are two distinct transfer functions corresponding to the components of the tangential surface magnetic field perpendicular and parallel to the direction of the wave vector of the external disturbance forcing the lunar induction. The dependences of these transfer functions on frequency and location are determined. The effects of the higher harmonics can: (1) account for a hitherto unexplained feature in the Apollo 12-Explorer 35 transfer functions, namely the rolloff at high frequencies; and (2) offer a possible explanation for the frequency dependence of the difference between the transfer functions for the two orthogonal components of the surface magnetic field. The harmonic response of a simple current layer model of the moon is derived. Author

N72-12822*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EQUILIBRIUM AND STABILITY OF THE GASEOUS COMPONENT OF THE GALAXY, 4
Sanford A. Kellman Nov. 1971 16 p refs Sponsored in part by NSF
(NASA-TM-X-65751; X-661-71-458) Avail: NTIS CSCL 03B

The stability of a self-gravitating, nonrotating, plane-parallel, isothermal gas layer with equipartition magnetic and cosmic ray components, immersed in a rigid isothermal layer of stars, is considered with respect to waves with motions perpendicular to the equilibrium magnetic and gravitational field vectors. The magnetic field and cosmic ray gas hinder gravitational instability and increase the minimum length necessary to produce instability. Author

N72-12823*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EQUILIBRIUM AND STABILITY OF THE GASEOUS COMPONENT OF THE GALAXY, 3
Sanford A. Kellman Nov. 1971 33 p refs
(NASA-TM-X-65760; X-661-71-444) Avail: NTIS CSCL 03B

The stability of a self-gravitating, nonrotating, isothermal gas layer threaded by a one-dimensional equipartition magnetic field, immersed in a rigid isothermal layer of stars, is considered with respect to waves with motions in and perpendicular to the X plane, where X is the equilibrium magnetic and gravitational field vectors. When motions are perpendicular to the X plane, the magnetic field hinders gravitational instability, increasing the minimum length necessary to produce instability by the factor (1 + alpha) to the 1/2 power, where alpha is the ratio of magnetic pressure to gas pressure. When motions are in the plane, no such simple analytical solution is found. However, the resulting system of equations reduces to a single fourth order differential equation in the perturbed gas potential that defines an eigenvalue problem for the marginally unstable state when the four appropriate boundary conditions are considered. Author

N72-12824*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EQUILIBRIUM AND STABILITY OF THE GASEOUS COMPONENT OF THE GALAXY, 2
Sanford A. Kellman (Maryland Univ., College Park) Nov. 1971 31 p refs Sponsored in part by NSF
(Grant NGL-21-002-033)
(NASA-TM-X-65759; X-661-71-443) Avail: NTIS CSCL 03B

A time-independent, linear, plane and axially-symmetric stability analysis was performed on a self-gravitating, plane-parallel, isothermal layer of nonmagnetic, nonrotating gas. The gas layer was immersed in a plane-stratified field isothermal layer of stars which supply a self-consistent gravitational field. Only the gaseous component was perturbed. Expressions were derived for the perturbed gas potential and perturbed gas density that satisfied both the Poisson and hydrostatic equilibrium equations. The equation governing the size of the perturbations in the mid-plane was found to be analogous to the one-dimensional time-independent Schrodinger equation for a particle bound by a potential well, and with similar boundary conditions. The radius of the neutral state was computed numerically and compared with the Jeans' and Ledoux radius. The inclusion of a rigid stellar component increased the Ledoux radius, though only slightly. Isodensity contours of the neutrual or marginally unstable state were constructed. Author

N72-12825*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STATISTICAL STUDIES IN STELLAR ROTATION 2: A METHOD OF ANALYZING ROTATIONAL COUPLING IN DOUBLE STARS AND AN INTRODUCTION TO ITS APPLICATIONS
P. L. Bernacca Nov. 1971 45 p refs
(NASA-TM-X-65758; X-671-71-440) Avail: NTIS CSCL 03C

The correlation between the equatorial velocities of the components of double stars is studied from a statistical standpoint. A theory of rotational correlation is developed and discussed with regard to its applicability to existing observations. The theory is then applied to a sample of visual binaries which are the least studied for rotational coupling. Consideration of eclipsing systems and spectroscopic binaries is limited to show how the degrees of freedom in the spin parallelism problem can be reduced. The analysis lends support to the existence of synchronism in closely spaced binaries. Author

N72-12826*# Washington Univ., St. Louis, Mo.
NASA MULTIDISCIPLINARY RESEARCH GRANT Final Report
[1971] 132 p
(Grant NGL-26-008-006)
(NASA-CR-124606) Avail: NTIS CSCL 12B

Research is discussed in the multidisciplinary areas of space and planetary science; materials and radiation; systems, instrumentation, and structures; and technology and man. Highlights are identified as an alpha-recoil track method of archeological dating; infrared astronomical telescope; reaction rates data, semiconductor radiation detectors, and analysis of time-dependent systems; Gunn effect devices for microwave generation and detection, mode-locked lasers, and radiation theory; and the application of a satellite communication system to educational development. Detectors to be flown on Apollo 16 to measure heavy particle flux in the solar wind and to be part of the HEAO-A experiment on extremely heavy nuclei in cosmic rays were developed. The impact of the multidisciplinary research on university activities is described, and individual departmental reports are included. N.E.N.

N72-12827# Lockheed Missiles and Space Co., Palo Alto, Calif.
FIRST DRILLING EXPERIMENT ON THE MOON
M. I. Smorodinov, V. P. Bulekov, D. D. Driuchenko, B. V. Zakharev, E. A. Motovilov, M. I. Smorodinov, Iu. N. Strelov, and V. V. Shvarev [1971] 8 p Transl. into ENGLISH from Kosm. Issled. (USSR), v. 9, no. 4, 1971 p 580-591
Avail: NTIS; National Translation Center, John Crerar Library, Chicago, Ill. 60616

A description is given of the equipment used to collect soil and rock samples from the moon. The methods of drilling and of selecting samples during the Luna 16 probe exploration are presented. The physical and mechanical properties of the rock samples, obtained from tests conducted on the lunar surface, and similar properties determined from experiments made on lunar rock analogues on earth are presented. K.P.D.

N72-12828# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
OBSERVATIONAL, THEORETICAL AND PREDICTED DATA ON THE INFRARED AND MICROWAVE SPECTRA OF EARLY-TYPE STARS
J. C. Pecker (College de France, Paris) 12 Oct. 1971 84 p refs
(JILA-109) Avail: NTIS

Theories on the causes and sources of emissions by stellar atmospheres are discussed. Data on infrared and microwave processes in early type stars are emphasized. Observational and predicted data are included. E.H.W.

N72-12829*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LUNAR MAGNETIC FIELD MEASUREMENTS, ELECTRICAL CONDUCTIVITY CALCULATIONS AND THERMAL PROFILE INFERENCES
D. S. Colburn Oct. 1971 40 p refs Submitted for publication
(NASA-TM-X-62093) Avail: NTIS CSCL 03B

Steady magnetic field measurements of magnitude 30 to 100 gamma on the lunar surface impose problems of interpretation when coupled with the nondetectability of a lunar field at 0.4 lunar radius altitude and the limb induced perturbations of the solar wind at the Explorer orbit. The lunar time-varying magnetic

field clearly indicates the presence of eddy currents in the lunar interior and permits calculation of an electrical conductivity profile. The problem is complicated by the day-night asymmetry of the moon's electromagnetic environment, the possible presence of the transverse magnetic mode, and the variable wave directions of the driving function. The electrical conductivity is calculated to be low near the surface, rising to a peak of .006/ohm meter at 250 km, dropping steeply inwards to a value of about .00005/ohm meter, and then rising toward the interior. A transition at 250 km depth from a high conductivity to a low conductivity material is inferred, suggesting an olivine-like core at approximately 800 C, although other models are possible.

Author

N72-12830*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

DESCRIPTION, DISSECTION, AND SUBSAMPLING OF APOLLO 14 CORE SAMPLE 14230

Roald Fryxell and Grant Heiken Oct. 1971 18 p refs

(NASA-TM-X-58070) Avail: NTIS CSCL 03B

Core sample 14230, collected at Triplet Crater near the Fra Mauro landing site of the Apollo 14 mission, was dissected in greater detail than any previous core. Sediment from the actual lunar surface was missing, and 6.7 grams of sediment were removed from the base of the core for a portion of the biotest prime sample. Upper and lower portions of the original 70.7-gram core (12.5 centimeters long) were fractured excessively but not mixed stratigraphically. Three major morphologic units and 11 subdivisions were recognized. Dissection provided 55 subsamples in addition to three others made by removing longitudinal sections of the core impregnated with n-butyl methacrylate for use as a permanent documentary record and for studies requiring particles of known orientation. Author

N72-12831*# National Aeronautics and Space Administration, Washington, D.C.

LIGHT CONDITIONS IN THE VENUSIAN ATMOSPHERE AND ESTIMATES OF THE OPTICAL CHARACTERISTICS APPLICABLE TO THE TASK OF PHOTOGRAPHING ITS CLOUDS AND SURFACE

Yu L. Biryukov, A. S. Panfilov, and L. G. Titarchuk Nov. 1971 31 p refs Transl. into ENGLISH of "Svetovoy Rezhim v Atmosfere Venery i Otsenki Opticheskikh Kharakteristik Primenitelno k Zadache Semiki Yeye Oblakov i Poverkhnosti," Acad. of Sci., USSR, Inst. for Space Res., Moscow, report Pr-55

(NASA-TT-F-13766; PR-55) Avail: NTIS CSCL 03B

Space probe and Earth-based measurements of Venusian optical characteristics are discussed for planetary photography. The cloud layer albedo is evaluated, and the surface radiation is computed to determine the longwave boundary of the photographic spectral range. Estimates are given of the distribution with altitude of atmospheric luminous fluxes and contrasts, surface brightness characteristics, and decrease of contrast with altitude. N.E.N.

N72-12832*# Martin Marietta Corp., Denver, Colo.

EXTENSIONS OF THE SPACE TRAJECTORIES ERROR ANALYSIS PROGRAMS Technical Report, Jul. - Sep. 1971

G. L. Adams, A. J. Bradt, and F. M. Peterson Sep. 1971 11 p (Contract NAS5-11873)

(NASA-CR-122298; MCR-71-270) Avail: NTIS CSCL 22C

A generalized covariance analysis technique which permits the study of the sensitivity of linear estimation algorithms to errors in a priori statistics has been developed and programed. Several sample cases are presented to illustrate the use of this technique. Modifications to the Simulated Trajectories Error Analysis Program (STEAP) to enable targeting a multiprobe mission of the Planetary Explorer type are discussed. The logic for the mini-probe targeting is presented. Finally, the initial phases of the conversion of the Viking mission Lander Trajectory Reconstruction (LTR) program for use on Venus missions is discussed. An integrator instability problem is discussed and a solution proposed. Author

N72-12833*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE OF AN ELECTRICALLY RAISED, SYNCHRONOUS SATELLITE WHEN SUBJECTED TO RADIATION DEGRADATION EFFECTS

James E. Cake and John D. Regetz, Jr. Washington Nov. 1971 21 p refs

(NASA-TM-X-2420; E-6477) Avail: NTIS CSCL 21C

The use of solar electric propulsion to raise a high-power communication satellite from a low altitude, inclined circular orbit of the geosynchronous orbit is evaluated. Since the satellite ascends through the high intensity radiation belts, the power available from the solar array and therefore to the ion thrusters degrades. The performance of the solar electric stage in combination with the thrust augmented Thor/Delta launch vehicle is evaluated for two thrust steering programs. The transfer times and solar array requirements are presented for total geosynchronous payloads from 450 to 1100 kg. Author

N72-12834# Naval Research Lab., Washington, D.C.

NRL PROGRESS REPORT, OCTOBER 1971

Oct. 1971 36 p refs

Avail: NTIS

A review of rocket astronomy from the V-2 rockets is presented, with emphasis on solar X-ray and Lyman alpha observations. Radiations associated with solar flares, the IGY 1958 eclipse, and Crab nebula are described. Brief technical notes are aiso presented on physical metallugy and corrosion, underwater transducers, electrochemistry, and antiicing additives for jet fuels. N.E.N.

N72-12835*# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research.

EFFECTS OF SURFACE ROUGHNESS ON THE PHOTOMETRIC PROPERTIES OF MARS

J. Veverka and L. Wasserman Jul. 1971 22 p refs

(Grant NGR-33-010-098)

(NASA-CR-124610; CRSR-456) Avail: NTIS CSCL 03B

Starting with a macroscopically flat surface, which at each point scatters according to the Minnaert law with exponent k, the photometric effects of increasing the large-scale roughness of the Martian surface were investigated. The photometric properties of macroscopically rough surfaces can still be described by the Minnaert law, but with an exponent k star, in general not equal to k. Therefore observed values of the Minnaert exponent cannot be used to infer the small-scale surface properties of Mars (or of any planet) unless proper allowance is made for the photometric effects of large-scale roughness. The azimuthal dependence of k star provides a sensitive test for the importance of these effects. Author

N72-12836*# Texas Univ., Austin. Applied Mechanics Research Lab.

AN ANALYSIS OF APPROACH NAVIGATION ACCURACY AND GUIDANCE REQUIREMENTS FOR THE GRAND TOUR MISSION TO THE OUTER PLANETS

Donald Wayne Jones Aug. 1971 158 p refs

(Grant NGR-44-012-008)

(NASA-CR-124641; AMRL-1025) Avail: NTIS CSCL 22C

The navigation and guidance process for the Jupiter, Saturn and Uranus planetary encounter phases of the 1977 Grand Tour interior mission was simulated. Reference approach navigation accuracies were defined and the relative information content of the various observation types were evaluated. Reference encounter guidance requirements were defined, sensitivities to assumed simulation model parameters were determined and the adequacy of the linear estimation theory was assessed. A linear sequential estimator was used to provide an estimate of the augmented state vector, consisting of the six state variables of position and velocity plus the three components of a planet position bias. The guidance process was simulated using a nonspherical model of the execution errors. Computation algorithms which simulate the

navigation and guidance process were derived from theory and implemented into two research-oriented computer programs, written in FORTRAN. Author

N72-12837*# Cornell Univ., Ithaca, N.Y. Lab. for Planetary Studies.
THE LONG WINTER MODEL OF MARTIAN BIOLOGY: A SPECULATION
Carl Sagan Aug. 1971 12 p refs Presented at the Viking Ann. Sci. Seminar, Langley Station, Va., 20 Apr. 1971
(Grant NGR-33-010-098)
(NASA-CR-124639; CRSR-455) Avail: NTIS CSCL 03B

An estimated mean thickness of about 1 km of frost in the Martian north polar cap summer remnant, if vaporized, would yield about 1000 g/sq cm of atmosphere over the planet, higher global temperatures through the greenhouse effect, and a greatly increased likelihood of liquid water. Vaporization of such cap remnants may occur twice each equinoctial precession, and Martian organisms may now be in cryptobiotic repose awaiting the end of the long precessional winter. The Viking biology experiments can test this hypothesis. Author

N72-12838# Academy of Sciences (USSR), Moscow.
THE UNIT AREA OF DISPERSION ON THE SURFACES OF THE MOON, MARS, AND VENUS IN THE RADIO FREQUENCY RANGE
N. N. Krupenio 1971 41 p refs In RUSSIAN
(PR-71) Avail: NTIS

Radio wave scattering characteristics are considered. These determine the energy potential of autonomous radiotechnical media for space navigation and control. The unit effective area of scattering during normal incidence and backscattering diagrams are discussed. Broadening of the backscattering diagram was noted for the Moon, Mars, and Venus with contraction along the wavelength. This broadening corresponds to an increase in the level of surface irregularity with basal diminution. Mars and Venus are characterized by a weaker dependence of scattering area on wavelength than is the Moon. This is due to the more frequent variation of electrophysical and mechanical properties of the ground with depth. Transl. by K.P.D.

N72-12839# Joint Publications Research Service, Washington, D.C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 264
15 Nov. 1971 53 p refs Transl. into ENGLISH from Russian report
(JPRS-54481; CSO-1866-W) Avail: NTIS

Materials from recent publications of the Sino-Soviet Bloc countries are presented in the form of abstracts and summaries. The topics covered are astronomy, meteorology, oceanography, geology, upper atmosphere, and space research. Author

N72-12840*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
REMOTE CONTROL AND NAVIGATION TESTS FOR APPLICATION TO LONG-RANGE LUNAR SURFACE EXPLORATION
William C. Mastin, Paul R. White, and Frank L. Vinz 1 Oct. 1971 56 p
(NASA-TM-X-64621) Avail: NTIS CSCL 03B

Tests conducted with a vehicle system built at the Marshall Space Flight Center to investigate some of the unknown factors associated with remote controlled teleoperated vehicles on the lunar surface are described. Test data are summarized and conclusions are drawn from these data which indicate that futher testing will be required. Author

N72-12841*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EQUILIBRIUM AND STABILITY OF THE GASEOUS COMPONENT OF THE GALAXY, 1
Sanford A. Kellman (Maryland Univ.) Oct. 1971 26 p refs
(Grant NGL-21-002-033)
(NASA-TM-X-65772; X-660-71-439) Avail: NTIS CSCL 03B

The distribution of gas satisfying hydrostatic and Poisson conditions with distance above the galactic plane is derived and compared with Schmidt's observations of the gas density, rho sub g (z). Equipartition magnetic and cosmic ray (Pc-r) components are assumed. The gas density is calculated for two limiting cases: (1) the total mass density at the galactic plane is equal to the sum of the observed gas and star densities in the solar neighborhood, and (2) Oort's data on the z component of the galactic gravitational acceleration are used. The rms z turbulent gas velocity dispersion is found. An expression is derived for the half-thickness of the equilibrium disk of galactic gas. Using the Innanen galactic mass model, the half-thickness is computed as a function of distance from the galactic center over the range 4kpc < or = R < or = 14kpc and compared to the observations of McGee and Milton. The observed increase in half-thickness at distances beyond the solar distance is reproduced theoretically. A galactic mass model is derived, using the observed layer half-width and constant value for Q. Author

N72-12842*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ION CLUSTERS AND THE VENUS ULTRAVIOLET HAZE LAYER
A. C. Aikin Nov. 1971 8 p refs
(NASA-TM-X-65773; X-625-71-459) Avail: NTIS CSCL 03B

The daytime ionosphere of Venus is observed between 100 and 500 km altitude with a peak electron concentration of 100,000/cc at 140 km. It is suggested that at altitudes less than 130 km the ion CO2(+)-CO2 is an important ionic constituent of the Venus ionosphere. Below 100 km ion clustering processes combine with the low temperature at the mesopause to form coagulates, giving rise to the ultraviolet haze layer observed. An atmospheric model is presented. Author

N72-12843*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA-RAY ABSORPTION FOR A BEAM MODEL OF THE CRAB NEBULA PULSAR NP0532
F. W. Stecker (NAS-NRC) and S. Tsuruta Nov. 1971 6 p refs Submitted for publication
(NASA-TM-X-65771; X-641-71-468) Avail: NTIS CSCL 03A

A model is discussed for determining gamma ray absorption from NP0532 by estimating the effect of beaming as indicated by the pulsations. The main absorption process is considered to be that of pair production in the intense photon field which occurs during the pulse. The results indicate that for this model absorption does not occur below 500 MeV. F.O.S.

N72-12844*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC FIELD MEASUREMENTS BY PIONEER 6. 1: HOURLY AVERAGES OF THE FIELD ELEMENTS FROM 17 DECEMBER 1965 TO 5 SEPTEMBER 1967 (BARTELS SOLAR ROTATION 1811 TO 1834)
Norman F. Ness and Franklin W. Ottens Nov. 1971 51 p refs
(NASA-TM-X-65767; X-690-71-449) Avail: NTIS CSCL 03B

Magnetic field data obtained on Pioneer 6 flights are presented in graph form as hourly averages. The spacecraft and magnetic field detector are described. The standard data analysis procedures are also given. K.P.D.

N72-12845*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE DEEP SPACE NETWORK, VOLUME 6 Progress Report, Sep. - Oct. 1971
15 Dec. 1971 197 p refs
(Contract NAS7-100)
(NASA-CR-124633; JPL-TR-32-1526-Vol-6) Avail: NTIS

CSCL 22A

Progress on Deep Space Network (DSN) supporting research and technology is presented, together with advanced development and engineering, implementation, and DSN operations of flight projects. The DSN is described. Interplanetary and planetary flight projects and radio science experiments are discussed. Tracking and navigational accuracy analysis, communications systems and elements research, and supporting research are considered. Development of the ground communications and deep space instrumentation facilities is also presented. Network allocation schedules and angle tracking and test development are included. Author

N72-12846*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

A REDUCED STAR CATALOG CONTAINING 537 NAMED STARS

Jack W. Rhoads 15 Nov. 1971 71 p refs
(Contract NAS7-100)
(NASA-CR-124573; JPL-TM-33-507) Avail: NTIS CSCL 03A

Positional and color magnitude data for the 537 named stars, are given. A brief translation of the star names and their source language is also presented. Author

N72-12847# Minnesota Univ., Minneapolis.

PROPER MOTION SURVEY WITH THE FORTY-EIGHT INCH SCHMIDT TELESCOPE. 24: FAINT STARS WITH LARGE PROPER MOTION

Willem J. Luyten 1 Jun. 1970 7 p
(Grants NSF GP-8082; NSF GP-9506)
Avail: NTIS

Data are given for 420 faint stars with large proper motion and double stars with common motion. Most of these are believed to be new, the only exceptions being those bright stars with known motions for which a new companion was found. In these cases data for both stars are entered. Author

N72-12848# Joint Publications Research Service, Washington, D.C.

SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 265

29 Nov. 1971 78 p refs Transl. into ENGLISH from various Sino-Soviet bloc publications
(JPRS-54577) Avail: NTIS

Materials from recent publications of the Sino-Soviet Bloc countries are presented in the form of abstracts, summaries, and occasionally full articles. The topics covered are astronomy, meteorology, oceanography, geology, upper atmosphere, and space research. Author

N72-12849*# Smithsonian Institution, Washington, D.C.

A SUMMARY OF PHASE ANALYSIS ON APOLLO 14 SAMPLES Final Report

Kurt Fredriksson, J. Nelen, A. Noonan, and Francois Kraut 1 Oct. 1971 56 p
(Grant NGR-09-015-148)
(NASA-CR-115252) Avail: NTIS CSCL 03B

The results of an analysis of lunar samples from Apollo 14 are presented. The large number of breccias returned from the Fra Mauro formation show that impact events are an important rock forming mechanism on the moon. Larger rocks as well as micro breccias bear structural resemblance to brecciated chondrites and terrestrial impactites. Many show evidence of repetitious events of break-up and accumulation welding. The surface of the regolith has become thoroughly mixed by this process. Most components however appear locally derived from basalts rich in feldspar and Kreep components, similar to rocks such as 14310. Author

N72-12850# Joint Publications Research Service, Washington, D.C.

EXTRATERRESTRIAL CIVILIZATIONS: PROBLEM AND CONSIDERATIONS

B. N. Panovkin 30 Nov. 1971 14 p refs Transl. into ENGLISH from Priroda (Moscow), no. 7, 1971 p 56-61
(JPRS-54590; UDC-523.07) Avail: NTIS

The density of planetary systems in the Universe and the probability of the development of life on planets and its evolution from the simplest forms to intelligent beings is briefly outlined. Emphasis is placed on the radio-astronomic aspect of the search for extraterrestrial civilizations. G.G.

N72-12851# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.

IMPLICATIONS OF THE HYPOTHESIS OF EXTINCT FISSIONING ISOTOPE IN THE PRIMITIVE METEORITES

M. Dakowski 1971 12 p refs Submitted for publication
(JINR-E15-5800) Avail: AEC Depository Libraries

It is shown that if the carbonaceous chondrite xenon anomaly was really caused by fission, then its progenitor was the most long-lived isotope of the superheavy elements with a half-life 2 million 6 + or - 10 to 7th power yr. In this case the search for superheavy elements synthesized prior to the formation of the solar system would be fruitless. Author (NSA)

N72-12852# Sandia Labs., Albuquerque, N.Mex.

A TECHNIQUE FOR DETERMINING APPROXIMATE ROLL RATE HISTORIES FOR BALLISTIC REENTRY VEHICLES HAVING MASS, INERTIA, AND AERODYNAMIC ASYMMETRIES

A. E. Hodapp, Jr. and E. L. Clark, Jr. Sep. 1970 87 p refs
(SC-RR-69-804) Avail: NTIS

A complete quasi-steady linear theory has been developed which predicts, for slender reentry vehicles, the trim angle and roll rate behavior resulting from the action of mass, inertia and aerodynamic asymmetries. Using this theory, a digital computer program, TARAN, has been developed. This program allows a detailed study of asymmetry-generated trim angle and roll rate behavior along reentry trajectories without requiring large quantitities of computer time. The effects of inertia asymmetries on trim angle and roll rate behavior were explored in detail. It is shown that inertia asymmetries are: (1) more effective than equivalent mass and aerodynamic asymmetries in generating trim angles over the super-resonant region of reentry flight; (2) equally as effective as resonance; and (3) less effective over the sub-resonant region. Author (NSA)

N72-12853# Academy of Sciences (USSR), Moscow. Inst. for Space Research.

ON THE NATURE OF QUASARS AND NUCLEI OF SEIFERT GALAXIES

I. S. Shklovsky 1970 56 p refs In ENGLISH and RUSSIAN
(PR-30) Avail: NTIS

An analysis of flux variation observed in some quasar and Seifert galaxies nuclei emissions at centimeter wavelengths is presented. The nature of this emission is discussed and is found to be of a synchrotron nature and to be caused by a large quantity of relatively weak flares occurring in the region of 0.7 parsecs. The nature of outbursts and the possiblity of observing powerful flares of gamma radiation are analyzed. It is shown that the main pair of quasar and Seifert nuclei energy is radiated in the gamma wavelength with an energy of 3 times 10 to the 47th power ergs. A time and spectrum variation study of gamma emission fluxes during the period of the flares is presented. ESRO

N72-12854# Academy of Sciences (USSR), Moscow. Inst. for Space Research.

OSCILLATIONS OF TYPE-1 COMET TAILS

A. I. Ershkovich, A. A. Nusinov, and A. A. Chernikov 1971 36 p refs In ENGLISH and RUSSIAN
(D-86) Avail: NTIS

To study wave motions in comets the tail is considered as a plasma cylinder exposed to the solar wind. It is shown that the

periodic variations of comet tail direction may be eigen modes excited by solar wind fluctuations and these are interpreted by taking into account the Kelvin-Helmholtz instability. ESRO

N72-12855# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
SOME CHARACTERISTICS OF VENUS SURFACE
N. N. Kroupenio 1971 30 p refs Presented at the 15th Gen. Assembly of LUGG, Moscow, Aug. 1971
(D-96) Avail: NTIS

The radar attenuation and refraction of the Venusian atmosphere was calculated from data on atmospheric temperature, pressure, and composition obtained from the Venera satellites. As a result, Venus radar measurements from earth were corrected and the surface radar scattering characteristics determined, enabling a dielectric constant for the surface layer to be computed. ESRO

N72-12856# Royal Inst. of Tech., Stockholm (Sweden). Lab. for Flight Techniques.
INVESTIGATION OF PERTURBATION TORQUES AND ATTITUDE DRIFT OF THE HEOS SATELLITE
Sven Hansson, A. Bertelrud, and L. M. Blix 23 Aug. 1971 138 p refs
(Contract ESOC-254/70/AR)
(KTH-AERO-FL-301) Avail: NTIS

A mathematical model is derived to explain the attitude drift of the HEOS 1 satellite since launch. It was found that of the perturbation torques examined, namely, solar, earth reflected and earth thermal radiation, aerodynamic drag, earth gravity gradient, and earth magnetic field, only the solar radiation torque was significant. ESRO

N72-12857*# Rice Univ., Houston, Tex. Dept. of Space Science.
FLYING INFRARED TELESCOPE OBSERVATIONS OF FAR INFRARED SOURCES Final Report, 1 Sep. 1969 - 31 Oct. 1970
Frank J. Low, Doyle A. Harper, Jr., Kendall R. Armstrong, and Carlton M. Gillespie, Jr. 28 Feb. 1971 18 p refs Sponsored in part by NASA
(Contract F19628-69-C-0302; ARPA Order 1366; AF Proj. 8692)
(NASA-CR-124644; AD-724719; Task-869205;
DoD-Element-62301D; AFCRL-71-0161) Avail: NTIS
CSCL 03/2

The Flying Infrared Telescope (described in Semi-Annual Technical Report No. 1) has been operational during the thirteen-month period ending 31 October 1970 with forty-six high altitude missions being flown. The total infrared luminosities of the galactic center and the Seyfert galaxy NGC-1068, the first extragalactic object to be observed at far-infrared wavelengths have been measured. Likewise, the long-wave infrared (45-750 micrometers) fluxes have been measured from eight sources associated with galactic H2 regions. The development of far infrared transmission filters used during observation of the H2 regions is discussed. Author (GRA)

N72-12174# Joint Publications Research Service, Washington, D.C.
STUDY OF LOCAL TERRAIN ALONG THE LUNOKHOD-1 TRAJECTORY
B. N. Rodionov, B. V. Nepoklonov, and V. V. Kiselev *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 97-112 refs (See N72-12168 03-11)
Avail: NTIS

N72-12175# Joint Publications Research Service, Washington, D.C.
DETERMINING GEOMETRIC DIMENSIONS AND DISTRIBUTION OF CRATERS TRAVERSED BY LUNOKHOD-1 ON LUNAR SURFACE
B. I. Garin, A. K. Leonovich, F. P. Pavlov, V. B. Georgiyev, and P. S. Semenov *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 113-119 (See N72-12168 03-11)
Avail: NTIS

N72-12176# Joint Publications Research Service, Washington, D.C.
STUDIES OF LUNAR GROUND MECHANICAL PROPERTIES WITH THE SELF-PROPELLED LUNOKHOD-1
A. K. Leonovich, V. V. Gromov, A. V. Rybakov, V. K. Petrov, P. S. Pavlov, I. I. Cherkasov, and V. V. Shvarev *In its* lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 120-135 (See N72-12168 03-11)
Avail: NTIS

N72-12177# Joint Publications Research Service, Washington, D.C.
THE RIFMA LUNAR AUTOMATIC SPECTROMETRIC APPARATUS
G. Ye. Kocharov, N. F. Borodulin, S. V. Viktorov, O. M. Voropayev, A. Yu. Dzevanovskaya, O. G. Ivanov, G. V. Kiryan, V. V. Petrov, and V. A. Sakulskiy *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 136-146 refs (See N72-12168 03-11)
Avail: NTIS

N72-12178# Joint Publications Research Service, Washington, D.C.
PRELIMINARY RESULTS OF GEOMORPHOLOGICAL STUDY OF PANORAMAS
K. P. Florenskiy, A. T. Bazilevskiy, A. A. Pronin, and Z. V. Popova *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 147-174 refs (See N72-12168 03-11)
Avail: NTIS

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N72-12858*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SYSTEM DEFINITION PHASE AND ACQUISITION PHASE PROJECT PLAN FOR SMALL ASTRONOMY SATELLITE SAS-D
[1971] 47 p
(NASA-TM-X-68801) Avail: NTIS CSCL 22B

The objective of the SAS-D project is to conduct spectral distribution studies of celestial ultraviolet sources using an Explorer-class spacecraft launched by a Delta vehicle into a geosynchronous orbit in the last half of 1975. The telescope system is intended for use by guest astronomers for a major portion of the total observing time. The concept of the overall system, designed to resemble functionally the operation of a ground-based observatory, should maximize the usefulness of the instrument to the astronomical community by limiting the amount of special instruction needed to use the spaceborne telescope. The SAS-D mission will obtain information on what stars, nebulae, and galaxies are and how they develop. Author

N72-12859*# Martin Marietta Corp., Baltimore, Md.
EXAMINATION OF THE ANOMALOUS BEHAVIOR OF THREE GRAVITY GRADIENT SATELLITES
Robert L. Goldman Mar. 1971 53 p refs
(Contract NAS5-21308)

(NASA-CR-122294; TR-71-07c) Avail: NTIS CSCL 22B

The anomalous oscillatory behavior of three satellites was examined. The satellites were all hinged, two-body, gravity gradient configurations passively stabilized about their three principal axes by gravity gradient and damper torques. Two basic behavior patterns were observed. Either the satellites were stable with attitude perturbations less than + or - 5 deg or their behavior tended towards a low frequency rigid body oscillation dominated by large yaw motions and in some cases by yaw inversions. A causal relationship between sun angle and the character of satellite behavior was observed which appears to indicate that thermal distortion is a critical factor in a gravity gradient satellite's dynamic behavior. The behavior appeared to be futher modified by the existence of response frequencies that were higher than anticipated values. Author

N72-12860*# Chrysler Corp., New Orleans, La.
SPACE SHUTTLE: AERODYNAMIC STABILITY AND CONTROL CHARACTERISTICS OF THE NASA/MSC .006 SCALE 040-A DELTA WING ORBITER
P. L. Click (Martin Marietta Corp., Denver, Colo.), D. J. Michana (Martin Marietta Corp., Denver, Colo.), and D. A. Sarver (Martin Marietta Corp., Denver, Colo.) Nov. 1971 858 p ref
(Contract NAS8-4016)
(NASA-CR-120015; DMS-DR-1186) Avail: NTIS HC $9.00/MF $0.95 CSCL 22B

Experimental aerodynamic investigations were made on a .006 scale model 040-A delta wing space shuttle orbiter configuration. These tests were conducted to determine six-degree-of-freedom force and moment data for preliminary stability and control analysis. Data were obtained over a Mach number range from 0.6 to 4.96 at angles of attack from -10 deg to 50 deg at zero degrees sideslip and at angles of sideslip from -10 deg to 10 deg at constants angles of attack of 0 deg, 15 deg, 30 deg, and 45 deg. Various aileron, elevator, (elevon) rudder and rudder flare deflection angles were tested to establish the control effectiveness and vehicle stability. Model component buildup data were also obtained to provide a data base for future configuration modifications. Plotted data results are presented in both the body and stability axis system. Author

N72-12861# Advisory Group for Aerospace Research and Development, Paris (France).
ATTITUDE STABILIZATION OF SATELLITES IN ORBIT
Sep. 1971 152 p refs
(AGARD-LS-45-71) Avail: NTIS

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6. PASSIVE AND SEMI-ACTIVE ATTITUDE STABILIZATIONS: DUAL SPIN SATELLITES P. W. Likins and P. Y. Willems (Louvain Univ.) 11 p refs (See N72-12864 03-21)
7. PASSIVE AND SEMI-ACTIVE ATTITUDES STABILIZATIONS: FLEXIBLE SPACECRAFT P. W. Likins (Calif. Univ., Los Angeles) 13 p refs (See N72-12865 03-21)
8. ACTIVE STABILIZATION W. G. Hughes (RAE, Farnborough, England) 17 p refs (See N72-12866 03-21)
9. STABILIZATION OF EOLE AND PEOLE SATELLITES P. Huguier (Centre Natl. D'Etudes Spatiales, Bretigny-Sur-Orge, France) 28 p (See N72-12867 03-21)
10. DEVELOPMENT RESULTS OF THE ESRO TD SATELLITE PNEUMATIC SYSTEM W. Iden (Erno Raumfahrttechnik G.m.b.H., Bremen, West Ger.) 20 p refs (See N72-12868 03-21)
11. THE SIRIO ATTITUDE MEASUREMENT AND CONTROL SYSTEM A. Buratti (Compagnia Industriale Aerospaziale S.p.A., Rome, Italy) 14 p (See N72-12869 03-21)
12. ATTITUDE CONTROL OF THE APOLLO SPACECRAFT R. H. Battin (Massach. Inst. of Tech., Cambridge) 10 p refs (See N72-12870 03-21)

N72-12862# Technische Hochschule Stuttgart (West Germany). Inst. a fuer Mechanik.
ROTATIONAL DYNAMICS **c21**
Martin A. Frik *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1971 14 p refs (See N72-12861 03-31)
Avail: NTIS

The fundamentals of the rotational dynamics of satellites are considered. Basic geometric and kinematic relations are reviewed and the Euler equations describing the rotational motion of rigid bodies are derived. The torque free motion of dynamically symmetrical as well as unsymmetrical satellites is investigated, including a stability analysis of permanent rotations about axes of principal moments of inertia. External torques, such as gravity-gradient, magnetic, aerodynamic, and solar radiation torques, which are caused by the interaction of an orbiting satellite with its environment, are discussed. Finally, for some types of nonrigid satellites the equations of motion are considered. Author

N72-12863*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACECRAFT ATTITUDE SENSORS WITH EMPHASIS ON THE ORBITING ASTRONOMICAL OBSERVATORY **c21**
Thomas E. Huber *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1971 16 p refs (See N72-12861 03-31)
(NASA-TM-X-67384) Avail: NTIS CSCL 22B

The sensors that provide references for the OAO control system are coarse sun sensors, fine sun sensors, Adcole aspect sensors, rate and position sensors, inertial reference unit, boresight tracker, gimbal star trackers, fixed head tracker, and magnetometers. The coarse and fine sun sensors are analog type sensors and are part of the OAO control loop. The aspect sensors are digital type and are used with the magnetometers primarily for attitude determination. The inertial sensors are used to slew or reposition the vehicle and are also used to inertially hold the spacecraft. The gimbal trackers and boresight tracker are used for stellar control holding the vehicle to an attitude accuracy of one arc minute. Author

N72-12864# Louvain Univ. (Belgium). Inst. de Mecanique.
PASSIVE AND SEMI-ACTIVE ATTITUDE STABILIZATIONS: DUAL SPIN SATELLITES **c21**
P. W. Likins and P. Y. Willems *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1971 11 p refs (See N72-12861 03-31)
Avail: NTIS

Dual-spin systems find space applications in missions for which the ability to point some instruments or a platform with a good spin stabilization is required. The equations of motion of a deformable system including internal momenta are derived. The equilibrium configurations of such a system in free space and in an inverse square field are obtained. The attitude stability of a deformable gyrostat, a convenient idealization of a dual-spin satellite, is investigated. The effect of dissipation in both sections of the system is discussed and a rigorous method permitting the stability determination is set forth. Author

N72-12865# California Univ., Los Angeles.
PASSIVE AND SEMI-ACTIVE ATTITUDE STABILIZATIONS: FLEXIBLE SPACECRAFT **c21**
Peter W. Likins *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1971 13 p refs (See N72-12861 03-31)
Avail: NTIS

The influence of spacecraft nonrigidity is identified as the pre-emient current problem in attitude stabilization of passive and semi-active spacecraft. Attitude control anomalies in the flight histories of eight satellites are attributed to nonrigidity, manifested either as unexpected internal energy dissipation or

unanticipated structural deformations. Recent progress in the development of methods for analysis of flexible spacecraft is surveyed, with attention to discrete coordinate methods, vehicle normal coordinate methods, and hybrid coordinate methods. New results are provided for each of these analytical procedures, and the utility of these results is discussed in the context of anticipated future spacecraft. Author

N72-12866# Royal Aircraft Establishment, Farnborough (England). Space Dept.
ACTIVE STABILIZATION **c21**
W. G. Hughes *In* AGARD Attitude Stabilization of Satellities in Orbit Sep. 1971 17 p refs (See N72-12861 03-31)
Avail: NTIS

A survey is given of the principal devices available for the generation of control torque, covering mass expulsion systems (cold gas, hot gas, electric), momentum exchange system (reaction wheels, control moment gyros), and magnetic torquers. For reaction wheel systems, the complete linearized equations of motion in three axes the effect of interaxis couplings are studied. Control in a single axis is considered in detail. Mass expulsion and magnetic techniques for momentum unloading are discussed. Control moment gyro systems are described. Pure jet systems are studied from the viewpoint of achieving high precision while preserving economy in the use of jet fuel. Difficulties arising from jet delay and sensor delay and noise are minimized by the use of a signal processing technique which incorporates a model of the spacecraft dynamics. Finally, the special properties of inertially referenced systems are considered, together with the gyrocompassing technique for use in earth-pointing spacecraft.
Author

N72-12867# Centre National d'Etudes Spatiales, Bretigny-Sur-Orge (France).
STABILIZATION OF EOLE AND PEOLE SATELLITES [STABILISATION DES SATELLITES EOLE ET PEOLE] **c21**
Philippe Huguier *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1971 28 p In FRENCH (See N72-12861 03-31)
Avail: NTIS

The orbits and stabilization simulations of the Eole and Peole satellites are discussed. Various methods, in particular the gravity gradient method, are discussed in detail. The accuracy of the methods was also determined. Data are included for the attenuation, energy dissipation, and the differences calculated for both satellites. Mathematical models are included.
Transl. by E.H.W.

N72-12868# Erno Raumfahrttechnik G.m.b.H., Bremen (West Germany).
DEVELOPMENT RESULTS OF THE ESRO TD SATELLITE PNEUMATIC SYSTEM
Werner Inden *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1971 20 p refs (See N72-12861 03-31)
Avail: NTIS

The attitude control requirements and principles of the ESRO TD satellite are reviewed, and the propulsion system are explained. The TD propulsion system is an argon cold gas system with no redundant parts which is based on the life time of 1/2 to 1 year in orbit. The test results of development, qualification, and flight acceptance are illustrated as the influence of the dynamic response on thrust, the problem of leakage and contamination, the regulation as a function of mission time. The successful subsystem qualifications, especially vibration tests, are shown. Development techniques for nozzles, system filling and leakage checkout are described. The performance of the small nozzles (0.02 N) used on TD is shown. Author

N72-12869# Compagnia Industriale Aerospaziale S.p.A., Rome (Italy).
THE SIRIO ATTITUDE MEASUREMENT AND CONTROL SYSTEM **c21**
Alessandro Buratti *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1971 14 p (See N72-12861 03-31)
Avail: NTIS

The Sirio attitude measurement and control subsystem components, their characteristics, their interconnection with other units, their mode of operation and how they are employed are described. Component test problems are discussed where appropriate, as in the case of the sensors and of the nutation damper. Emphasis is given to attitude measurement and an estimate of the accuracy which may be achieved both in the transfer and in the geostationary orbit is given. Author

N72-12870# Massachusetts Inst. of Tech., Cambridge. Charles Stark Draper Lab.
ATTITUDE CONTROL OF THE APOLLO SPACECRAFT **c21**
Richard H. Battin *In* AGARD Attitude Stabilization of Satellites in Orbit Sep. 1917 10 p refs (See N72-12861 03-31)
Avail: NTIS

The digital computer is the central control element in the Apollo control, guidance, and navigation system. The primary autopilots of the various spacecraft configurations of Apollo are implemented digitally in this general purpose processor. Successful control system design was made possible by capitalizing on the nature of digital processing and exploiting the attendant flexibility and nonlinear computability. After a brief description of the control system hardware, a detailed treatment of one of these autopilots, coasting flight attitude control, is given. Author

N72-12871*# Old Dominion Univ., Norfolk, Va.
VIBRATION ANALYSIS OF A 1/15 SCALE DYNAMIC MODEL OF A SPACE SHUTTLE CONFIGURATION
E. A. Thornton [1971] 146 p refs
(Contract NAS1-0434-20)
(NASA-CR-111984) Avail: NTIS CSCL 22B

The natural frequencies and mode shapes of a 1/15 scale space shuttle dynamics model are analytically determined. The model, a parallel beam type structure with delta wings, is dynamically representative of the stiffness and mass properties of an early space shuttle design. Important characteristics of the model are elastic interfaces with adjustable spring rates. Normal mode computations are made using the finite element modeling technique as implemented in the NASTRAN (NASA Structural Analysis) computer program. The feasibility of neglecting elastic deformations in the lower modes was investigated using a rigid body model. Using NASTRAN, natural frequencies and mode shapes were first calculated for the booster fuselage, orbiter fuselage, and both delta wings in a free-free condition. Next, the fuselages were connected for various spring rates. Then the wings were attached to each fuselage, and the booster and orbiter were analyzed as separate airplanes. Finally, the two airplanes were elastically joined, and the complete model was analyzed. Author

N72-12872*# Grumman Aerospace Corp., Bethpage, N.Y.
LM-11 ACTUAL WEIGHT REPORT
D. Cunnius 1 Jun. 1971 44 p refs
(Contract NAS9-1100)
(NASA-CR-115224; LTR-490-213) Avail: NTIS CSCL 22B

The procedure for obtaining the weight and center of gravity checks is defined along with the official recordings of the measurements by stage of LM-11. A.L.

N72-12873*# National Aeronautics and Space Administration, Washington, D.C.
NASA SOUNDING ROCKETS, 1958 - 1968: A HISTORICAL SUMMARY
William R. Corliss 1971 162 p refs
(NASA-SP-4401; LC-70-169175) Avail: NTIS; SOD $1.75 CSCL 16A

The development and use of sounding rockets is traced from the Wac Corporal through the present generation of

rockets. The Goddard Space Flight Center Sounding Rocket Program is discussed, and the use of sounding rockets during the IGY and the 1960's is described. Advantages of sounding rockets are identified as their simplicity and payload simplicity, low costs, payload recoverability, geographic flexibility, and temporal flexibility. The disadvantages are restricted time of observation, localized coverage, and payload limitations. Descriptions of major sounding rockets, trends in vehicle usage, and a compendium of NASA sounding rocket firings are also included. N.E.N.

N72-12874*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACECRAFT ORBIT/EARTH SCAN DERIVATIONS, ASSOCIATED APL PROGRAM, AND APPLICATION TO IMP-6
Gene A. Smith Oct. 1971 76 p refs
(NASA-TM-X-65750; X565-71-442) Avail: NTIS CSCL 22C

The derivation of a time shared, remote site, demand processed computer program is discussed. The computer program analyzes the effects of selected orbit, attitude, and spacecraft parameters on earth sensor detections of earth. For prelaunch analysis, the program may be used to simulate effects in nominal parameters which are used in preparing attitude data processing programs. After launch, comparison of results from a simulation and from satellite data will produce deviations helpful in isolating problems. Author

N72-12875*# National Aeronautics and Space Administration, Washington, D.C.
PAYLOAD IMPACT OF SPACE SHUTTLE AND TUG
Homer E. Newell 1970 42 p Presented at the ELDO/NASA Space Transportation Systems Briefing, Bonn, 7-8 Jul. 1970
(NASA-TM-X-67401) Avail: NTIS CSCL 22B

The advantages offered by space shuttle and tug for space operations are summarized. Economical transportation to a space station and operations in orbit; frequent sorties, with flexible scheduling, for experiment missions; and an economical and flexible replacement for conventional launchers are discussed. These advantages include many potential benefits for payload design, construction, and use. ESRO

N72-12876*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ATLAS-CENTAUR AC-18 PERFORMANCE EVALUATION FOR APPLICATIONS TECHNOLOGY SATELLITE ATS-5 MISSION
Washington Nov. 1971 146 p ref
(NASA-TM-X-2383; E-6284) Avail: NTIS CSCL 22D

The Atlas-Centaur with the ATS-5 spacecraft was successfully launched from Eastern Test Range on August 12, 1969, and the ATS-5 was placed in the required highly elliptical transfer orbit with apogee near synchronous altitude. From this orbit the ATS-5, using its apogee motor, achieved the desired near-synchronous circular equatorial orbit. All launch vehicle systems performed satisfactorily. Author

N72-12877*# Chrysler Corp., New Orleans, La. Space Div.
SPACE SHUTTLE: BASIC SUBSONIC STATIC AERODYNAMIC CHARACTERISTICS FOR GRUMMAN H-33 ORBITER CONFIGURATION (M EQUALS 0.17)
W. Jung (Grumman Aerospace Corp.) and F. Carlucci (Grumman Aerospace Corp.) Nov. 1971 98 p
(Contract NAS8-4016)
(NASA-CR-120006; DMS-DR-1167; NASA-Ser-S-0615) Avail: NTIS CSCL 22B

Results of an experimental aerodynamic investigation of the H-33 space orbiter are presented. The investigation was undertaken to determine static aerodynamic characteristics of the orbiter at a Mach number of 0.17. These data were determined by employing a 1/25 scale model of the orbiter for pitch and yaw variations of -4 degrees to 24 degrees to 15 degrees, respectively. Investigations were conducted in the 7 - by - 10 foot wind tunnel. Author

N72-12878*# Chrysler Corp., New Orleans, La. Space Div.
SPACE SHUTTLE: HEAT TRANSFER RATE MEASUREMENTS ON CONVAIR BOOSTER (B-15B-2) AND NORTH AMERICAN ROCKWELL ORBITER (161B) AT NOMINAL MACH NUMBER OF 8
J. D. Warmbrod (MSFC), W. R. Martindale (ARO, Inc.), and R. K. Matthews (ARO, Inc.) Nov. 1971 166 p
(Contract NAS8-4016)
(NASA-CR-120009; DMS-DR-1177-Vol-1; NASA-Ser-H-1009-Vol-1) Avail: NTIS CSCL 22B

Plotted and tabulated data from the thin-skin thermocouple phase of an experimental test program are presented. These data are representative of three events of simulated flight and are described as booster-orbiter ascent heating data, booster reentry heating data, and orbiter reentry heating data. The test was conducted in a 50-inch hypersonic tunnel b at a nominal Mach number of 8 and free-stream Reynolds number range of 700,000 to 3,700,000 per foot. The model employed was a 0.009 scale replica of the Convair B-15B-2 booster and North American Rockwell 161B orbiter. Author

N72-12879*# Chrysler Corp., New Orleans, La. Space Div.
SPACE SHUTTLE: STATIC STABILITY CHARACTERISTICS AND CONTROL SURFACE EFFECTIVENESS OF THE BOEING .00435 SCALE MODEL SPACE SHUTTLE BOOSTER H-32
Jacque F. Houser and Wm. H. Runciman Nov. 1971 121 p
(Contract NAS8-4016)
(NASA-CR-120002; DMS-DR-1158) Avail: NTIS CSCL 22B

Experimental aerodynamic investigations were made in the Grumman 36-inch hypersonic wind tunnel on a .00435 scale model of the H-32 reusable space shuttle booster. The objectives of the test were to determine the static stability characteristics and control surface effectiveness at hypersonic speeds. Data were taken at M = 8.12 over a range of angles of attack between -5 and 85 deg at beta = 0 deg and over a range of side slip angles between -10 and 10 deg at alpha = 0 and 70 deg. Six component balance data and base-cavity pressure data were recorded. Author

N72-12880*# Avco Corp., Wilmington, Mass. Systems Div.
HEAT SOURCE REENTRY VEHICLE DESIGN STUDY
R. L. Ryan Oct. 1971 336 p refs
(Contract NAS3-14397)
(NASA-CR-72875; AVSD-0429-71-RR) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

The design details are presented of a flight-type heat source reentry vehicle and heat exchanger compatible with the isotope Brayton power conversion system. The reference reentry vehicle and heat exchanger were modified, orbital and superorbital capability was assessed, and a complete set of detail design layout drawings were provided. Author

N72-12881# Lockheed Missiles and Space Co., Palo Alto, Calif.
DOCKING IN SPACE
V. Guliaev and V. Pozdniak [1971] 4 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 9, 1971 p 40-41
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The closure and docking of space objects is discussed. Special reference is made to space shuttles, the Soyuz and Salyut spacecraft, and orbital stations. Author

N72-12882*# Auburn Univ., Ala.
TIME DOMAIN AND FREQUENCY DOMAIN DESIGN TECHNIQUES FOR MODEL REFERENCE ADAPTIVE CONTROL SYSTEMS
Joseph S. Boland, III 15 Oct. 1971 173 p refs

(Contract NAS8-26580)
(NASA-CR-121031; TR-2) Avail: NTIS CSCL 22B

Some problems associated with the design of model-reference adaptive control systems are considered and solutions to these problems are advanced. The stability of the adapted system is a primary consideration in the development of both the time-domain and the frequency-domain design techniques. Consequentially, the use of Liapunov's direct method forms an integral part of the derivation of the design procedures. The application of sensitivity coefficients to the design of model-reference adaptive control systems is considered. An application of the design techniques is also presented. Author

N72-12883*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INVESTIGATION OF A CLAMSHELL ROLL-OUT EJECTION CONCEPT
Lawrence F. Hatakeyama Washington Nov. 1971 61 p refs
(NASA-TN-D-6458; G-1033) Avail: NTIS CSCL 22B

The equations for the motion, forces, and couples generated by clamshells released from spinning sounding rockets in accordance with a roll-out ejection concept are presented. The application of these equations to a study of a system for the Javelin rocket vehicle is discussed. The roll-out ejection concept advocated requires that each deploying clamshell be pivoted about an axis at its trailing edge located in the system sectioning plane. Clamshell despinning is a consequence of this deployment since the pivotal rate is in opposition to the rocket vehicle spin. The energy required by the deployment is derived largely from the rotational energy of the clamshell. Thus, the rocket vehicle will not be significantly despun by this kind of clamshell deployment. This ejection concept also permits a system design which makes it possible to limit clamshell angular motion to rotation about that one of its centroidal principal axes which is brought into parallelism with the rocket vehicle longitudinal axis. Also, by equalizing the moments of inertia about the other centroidal principal axes, the roll-out motion can be decoupled from any extraneous angular motion about these axes. Author

N72-12884*# Avco Corp., New York. Systems Div.
A STUDY OF THE FLEXIBLE BODY DYNAMICS OF THE RAE-A SATELLITE Final Report
Mar. 1971 84 p refs
(Contract NAS5-11192)
(NASA-CR-124642; AVSD-0154-71-RR) Avail: NTIS CSCL 22B

Spacecraft flight data was compared with simulated data computed by the RAE and IMP dynamics simulator computer programs. There was not sufficient data available to provide definitive data on antenna boom position to the Radio Astronomy experimenter. There was, however, enough data to indicate the trend of antenna boom stiffness and temperature gradient. It was possible to obtain a good fit of simulated data to measured spacecraft attitude data when the antenna booms were extended to 450 feet. The value of the RAE-A antenna boom stiffness appears to be significantly less than the preflight ground measured value. It was confirmed that an improved simulation can be obtained by using values of the root angles of the antenna booms and by using an angle of the damper plane of motion, relative to the plane of the antennas, which differed from preflight ground measurements. Author

N72-12885*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND PRELIMINARY TESTING OF A BRAYTON SPACE RADIATOR CONCEPT
Thomas J. Miller, James P. Couch, and George M. Prok Washington Nov. 1971 17 p refs
(NASA-TM-X-2401; E-6295) Avail: NTIS CSCL 20M

A low-temperature radiator has been designed to reject 17.62 kW of thermal power from an isotope Brayton power system. This power system has an electrical output of 7.1 kW. The total radiator consists of two radiators connected in series. Both radiators have a redundant coolant loop, shared fins, and are close to flight configuration. A silicone oil is used as the working fluid. Low flow rates and moderate pressure drop in the radiator required a small hydraulic diameter with large heat transfer area and large flow area. To obtain these characteristics and meet schedule limitations, an expanded tube configuration (with an approximately trapezoidal cross section) was selected. Because of the low flow rates and unconventional tube shape, small scale tests were performed to evaluate the validity of existing heat transfer and pressure drop correlations to this case. The results of these tests were in good agreement with predictions. Author

N72-12886*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANALYSIS OF SELECTED DEEP SPACE MISSIONS
William S. West, Michael L. Holman, and Herbert W. Bilsky Washington Nov. 1971 109 p refs
(NASA-TR-R-372; G-1030) Avail: NTIS CSCL 22A

Task 1 of the NEW MOONS (NASA Evaluation With Models of Optimized Nuclear Spacecraft) study is discussed. Included is an introduction to considerations of launch vehicles, spacecraft, spacecraft subsystems, and scientific objectives associated with precursory unmanned missions to Jupiter and thence out of the ecliptic plane, as well as other missions to Jupiter and other outer planets. Necessity for nuclear power systems is indicated. Trajectories are developed using patched conic and n-body computer techniques. Author

N72-12887*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRELIMINARY GODDARD GEOPOTENTIAL USING OPTICAL TRACKING DATA AND A COMPARISON WITH SAO MODELS
F. J. Lerch, C. A. Wagner, B. H. Putney, and K. G. Nickerson (Computer Science Corp.) Oct. 1971 25 p refs Presented at DOD Geodesy/Gravity Tech. Exchange Meeting, Gaithersburg, Md., 21 Apr. 1971
(NASA-TM-X-65762; X-552-71-143) Avail: NTIS CSCL 22B

A preliminary Goddard Space Flight Center (GSFC) geopotential and center of mass station coordinate solution was obtained from satellite orbital data using numerical integration theory. This geodetic solution is a prelude to a more general solution which will combine the 1971 International Satellite Geodesy Experiment (ISAGEX) laser data with the present data being employed. The present GSFC geopotential solution consists of the spherical harmonic coefficients through degree and order eight with higher order satellite resonant coefficients. The solution represents a first iteration result from 17 satellites with approximately 150 weekly orbital arcs containing some 40,000 optical observations. The GSFC preliminary result is compared with final results from the Smithsonian Astrophysical Observatory (SAO) solutions including the 1969 SAO Standard Earth II solution. One aspect of interest for the comparison is that SAO uses an analytic theory for the orbital solution whereas GSFC uses a numerical integration theory. The comparison of geopotential results shows that good agreement exists in general but that there are some areas of minor differences. Author

N72-12888*# Boeing Co., Seattle, Wash. Aerospace Group.
ACTIVE CLEANING TECHNIQUE FOR REMOVING CONTAMINATION FROM OPTICAL SURFACES IN SPACE Quarterly Progress Report, 1 Aug. - 1 Nov. 1971
R. B. Gillette and W. D. Beverly Nov. 1971 44 p refs
(Contract NAS8-26385)
(NASA-CR-121040; QPR-3) Avail: NTIS CSCL 22B

Plasma cleaning experiments were completed on hydrocarbon contaminant films, experiments were initiated to determine a satisfactory technique for depositing contaminant films, and an experiment was conducted to determine whether specimens are being thermally cleaned rather than plasma cleaned. Results of plasma cleaning experiments on hydrocarbon contaminant films showed that the optical properties of mirrors and gratings could

be satisfactorily restored. Results on fused silica optical flats were inconclusive because of the insensitivity of measurement techniques to the contaminant films. White thermal control surfaces, degraded by the hydrocarbon contaminant film, could not be restored by oxygen plasma exposure. The reflectance of silvered FEP Teflon thermal control surfaces could be restored by plasma cleaning. Experiments with a silicone contaminant indicated that it could not be easily polymerized onto surfaces with ultraviolet radiation. Results of the thermal cleaning experiment showed that the polymerized hydrocarbon contaminant film could not be removed by heating in vacuum to a temperature in excess of that expected during plasma cleaning. Author

N72-12889# Joint Publications Research Service, Washington, D.C.
ROCKETS: INTERNATIONAL EFFORTS AND BATCHING PROBLEMS
2 Nov. 1971 9 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 9, Sep. 1971 p 26-29
(JPRS-54378) Avail: NTIS

The problems in determining the precise amount of fuel used in a large rocket or spacecraft launching are discussed in terms of volumetric batching. Factors which affect the amount of fuel are: temperature, variations of fluid level during filling, volatility, and concentration. In addition, cooperation between the Soviet Union and other countries in the investigation of outer space for peaceful purposes is discussed. F.O.S.

N72-12890*# Techtran Corp., Glen Burnie, Md.
MUST THE TEST PROGRAM FOR THE EUROPA ROCKETS BE REVISED?
Jacques Morisset Washington NASA Dec. 1971 10 p Transl. into ENGLISH from Air Cosmos (France), no. 410, 20 Nov. 1971 p 20-22
(Contract NASw-2037)
(NASA-TT-F-14081) Avail: NTIS CSCL 22C

The sequence of failures in the Europa rocket program was analyzed from the standpoint of determining the course of future action. It was felt that in view of the commitments already made and the disruption of industry and employee layoffs that a suspension of the program would entail, the program would proceed, perhaps at an accelerated pace. The reasons for the F-11 failure are given. Author

N72-12891*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRANSPORTATION AND HANDLING LOADS Space Vehicle Design Criteria (Structures)
F. E. Ostrem Sep. 1971 48 p refs
(NASA-SP-8077) Avail: NTIS CSCL 22B

Criteria and recommended practices are presented for the prediction and verification of transportation and handling loads for the space vehicle structure and for monitoring these loads during transportation and handling of the vehicle or major vehicle segments. Elements of the transportation and handling systems, and the forcing functions and associated loads are described. The forcing functions for common carriers and typical handling devices are assessed, and emphasis is given to the assessment of loads at the points where the space vehicle is supported during transportation and handling. Factors which must be considered when predicting the loads include the transportation and handling medium; type of handling fixture; transport vehicle speed; types of terrain; weather (changes in pressure of temperature, wind, etc.); and dynamics of the transportation modes or handling devices (acceleration, deceleration, and rotations of the transporter or handling device). Author

N72-12892*# National Aeronautics and Space Administration, Washington, D.C.
WHAT MADE APOLLO A SUCCESS?
1971 87 p Repr. from Astronaut. Aeron., Mar. 1970
(NASA-SP-287) Avail: NTIS CSCL 22B

Spacecraft development, mission design planning, flight crew operations, and flight operations are considered. Spacecraft design principles and test activities are described. Determination of the best series of flights leading to a lunar landing at the earliest possible time, flight planning, techniques for establishing flight procedures and carrying out flight operations, and crew training and simulation activities are discussed. Author

N72-12893# National Research Council of Canada, Ottawa (Ontario). Space Research Facilities Branch.
BLACK BRANT ROCKET AMF-II-115 LAUNCHED AT CHURCHILL RESEARCH RANGE, 19 MARCH 1971
Oct. 1971 17 p refs
(SRFB-060; PD-13079; Operations-Req-7015) Avail: NTIS

The engineering aspects of preparing the payload and launching Black Brant rocket AMF-II-115 into a distinct and sustained auroral event are discussed. This vehicle carried a recoverable payload which had previously been flown in Black Brant AMF-II-117. Experiments included auroral spectrum photometry, thin film tests, vacuum ultraviolet photometer and ionization density measurements. Three packages were re-flown, while the thin film test replaced one other experiment. AMF-II-115 performed as scheduled, including soft landing of the payload with good experimental data being obtained, except for the spectrograph which was only partially sucessful. Author

N72-12894# National Research Council of Canada, Ottawa (Ontario). Space Research Facilities Branch.
BLACK BRANT ROCKET AAF-VB-32 LAUNCHED AT CHURCHILL RESEARCH RANGE, 3 MARCH 1971
Oct. 1971 29 p refs
(SRFB-059; PD-13078; Operations-Req-7016) Avail: NTIS

The engineering aspects of preparing the payload and launching Black Brant rocket AAF-VB-32 are discussed. The payload included ten experiments to measure energetic particles, auroral emissions, electron temperature and energy distribution, rotational temperatures and number densities of atomic oxygen, molecular oxygen, nitrogen and helium, ambient temperatures, electric fields and magnetic field variations, plasma characteristics, and the detection of relative speed and direction of impacting hypervelocity micrometeoroids. The vehicle performed as predicted, and good data were obtained. Author

N72-12895*# Chrysler Corp., New Orleans, La. Space Div.
SPACE SHUTTLE: HEAT TRANSFER RATE MEASUREMENTS OF NORTH AMERICAN ROCKWELL ORBITER (161B) AT NOMINAL MACH NUMBER OF 8
J. D. Warmbrod (MSFC), W. R. Martindale (ARO, Inc.), and R. K. Matthews (ARO, Inc.) Dec. 1971 115 p
(Contract NAS8-4016)
(NASA-CR-120029; DMS-DR-1177-Vol-3; NASA-Ser-H-1009-Vol-3) Avail: NTIS CSCL 22B

Plots and tables which determine detailed heat transfer distributions on phase B space shuttle configurations are presented. A thin-skinned thermocouple was used to measure the reentry events of the delta wing orbiter. Data was obtained at a nominal Mach number of 8 and free stream Reynolds numbers ranging from 0.83 x 10 to the 6th power to 3.76 x 10 to the 6th power per foot. Angle of attack was varied from -5 to 50 degrees. Author

N72-12896*# North American Rockwell Corp., Downey, Calif. Space Div.
SPACE SHUTTLE PHASE B STUDY PLAN
B. Hello 4 Nov. 1971 100 p
(Contract NAS9-10960)
(NASA-CR-115277; MSC-03330; SD-71-343) Avail: NTIS CSCL 22B

Phase B emphasis was directed toward development of data which would facilitate selection of the booster concept, and main propulsion system for the orbiter. A shuttle system is also

defined which will form the baseline for Phase C program activities. Author

N72-12897*# General Electric Co., Houston, Tex.
CREW INTERFACE SPECIFICATION DEVELOPMENT STUDY FOR IN-FLIGHT MAINTENANCE AND STOWAGE FUNCTIONS Final Report
John G. Carl 30 Jun. 1971 154 p refs
(Contract NAS9-11336)
(NASA-CR-115281) Avail: NTIS CSCL 22B

The need and potential solutions for an orderly systems engineering approach to the definition, management and documentation requirements for in-flight maintenance, assembly, servicing, and stowage process actvities of the flight crews of future spacecraft were investigated. These processes were analyzed and described using a new technique (mass/function flow diagramming), developed during the study, to give visibility to crew functions and supporting requirements, including data products. This technique is usable by NASA for specification baselines and can assist the designer in identifying both upper and lower level requirements associated with these processes. These diagrams provide increased visibility into the relationships between functions and related equipments being utilized and managed and can serve as a common communicating vehicle between the designer, program management, and the operational planner. The information and data product requirements to support the above processes were identified along with optimum formats and contents of these products. The resulting data product concepts are presented to support these in-flight maintenance and stowage processes. Author

N72-12898# Committee on Space Research (COSPAR), Paris (France).
THE FEASIBILITY OF THE FIRST GARP GLOBAL EXPERIMENT (FGGE) AND THE CRITICALITY OF INITIATING SYSTEMS PLANNING
Jan. 1971 43 p refs
Avail: NTIS

A critical appraisal of satellite observational facilities prepared by COSPAR Working Group No. 6 is presented including those recently developed, those in the planning stage, and those which may be developed in the future. The report also considers what satellite and satellite-related observational systems could reasonably be expected to be available in time for use in a global experiment in 1973 and what additional facilities might become available before 1976. Existing meteorological satellite prospects of different countries are reviewed and the prospect for the development of critical spacecraft and nonspacecraft subsystems are examined. ESRO

N72-12899# Royal Aircraft Establishment, Farnborough (England).
TABLE OF EARTH SATELLITES. VOLUME 2, PARTS 1 AND 2: 1969 AND 1970
J. A. Pilkington, D. G. King-Hele, and H. Hiller Apr. 1971 84 p refs
(RAE-TR-71082; RAE-TR-70020) Avail: NTIS

All known artificial satellites launched between 1 January 1969 and 31 December 1970 are listed chronologically. Lifetimes, weights, dimensions, and orbital details are given for instrumented satellites and their final-stage rockets. Other fragments from satellites are listed without these details. The methods used in compiling the table are described. Author (ESRO)

N72-12900# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
INVESTIGATION OF SOLAR SYSTEM EVOLUTION BY AUTOMATIC VEHICLES ON THE MOON
G. I. Petrov 1971 25 p
(D-107) Avail: NTIS

The standard automatic platform used in the USSR for lunar exploration is discussed. The trajectory corrections and landing system are analyzed. Lunokhod, the roving automatic lunar laboratory is described including details analyzing the propulsion system, remote control, motion and direction capabilities, and its performance as scientific and communication equipment. Tasks which could be performed in the future by Lunokhod are listed including the delivery of lunar rock samples to earth, and the study of the interior structure of the moon. The latter task includes long term seismic observations, automatic determination of lunar surface point coordinate determination, study of the moon's electric conductivity up to a depth of 600 kilometres for evaluating temperature and chemical composition, and finally the study of the lunar geology for cosmological evaluation. ESRO

N72-12901# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
STOPWATCH OBSERVATIONS OF SATELLITES, JUNE 1971
R. D. Eberst 5 Oct. 1971 13 p
(ROE-STS-115) Avail: NTIS

Stopwatch observations made at stations during June 1971 are listed in launch and time order for each satellite. Various subtotals are given. Author (ESRO)

N72-12902# Allied Research Associates, Inc., Concord, Mass.
DEVELOPMENT OF TECHNIQUES FOR THE OPERATIONAL Final Report, 21 May 1970 - 21 May 1971
James H. Williard and James R. Greaves May 1971 135 p refs
(Contract N62306-70-C-0443)
(AD-726304; ARA-8G80-F; FAMOS-TN-2-71) Avail: NTIS CSCL 22/2

Two broad classes of data processing programs were developed. The first type extracts and prepares for transmission full-resolution subsets of the original ITOS array. The data product is ideal for detailed research studies or for transmission to remote locations not equipped to directly read out the ITOS sensor systems. The second class of program compresses the original full hemisphere data arrays by averaging or by selecting maximum or minimum values. The new array is then prepared for transmission. This data product is particularly useful for input to global environmental prediction models. Additional support programs were developed to output the data products described above onto either a CRT or printer display. These displays were used to perform tradeoffs between the data preparation and transmission times and the scientific or meteorological usefulness of the various data products. It was found that a factor of four reduction in resolution of the original ITOS array yields a data product which is transmittable in an acceptable period of time and which is as useful for most purposes as the original array. GRA

N72-12903# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
VERTICAL WIND EFFECTS ON THE 2.75-INCH ROCKET
Bernard F. Engebos and Laurence J. Rider Mar. 1971 29 p refs
(DA Proj. 1T0-61102-B-53-A)
(AD-726321; ECOM-5365) Avail: NTIS CSCL 19/7

Effects of vertical wind on the horizontally launched 2.75-inch rocket are discussed. The vertical unit wind effect is an order of magnitude greater than the horizontal unit wind effect, thus playing an important role in the impact point of the rocket. A novel approach to the generation of a ballistic factor curve is presented. It is shown that approximately 90 percent of the total wind effect on the rocket occurs in the first 400 feet of the horizontal range. Finally, a proposed meteorological system for wind compensation is presented. Author (GRA)

N72-12904# Army Missile Command, Redstone Arsenal, Ala. Aeroballistics Directorate.
OPTIMAL TRACKING LAWS
Richard E. Dickson 27 May 1971 20 p refs

(DA Proj. 1M2-62303-A-214)
(AD-728456; RD-TM-71-4) Avail: NTIS CSCL 16/2

The method of solution of inhomogeneous linear-quadratic optimization problems, which was previously applied to the intercept problem, is applied to the tracking problem. How the higher derivatives of the relative motion are incorporated in the control law is shown. The results have application of line-of-sight tracking systems. Author (GRA)

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N72-12905*# Lockheed-Georgia Co., Marietta.
SKIN-STRINGER PANEL NORMAL MODE RESPONSE EXPERIMENTAL DATA AND FINITE ELEMENT COMPUTER PROGRAM DOCUMENTATION
F. F. Rudder, Jr. [1971] 194 p refs Supplement to NASA-CR-1959
(Contract NAS1-9526)
(NASA-CR-111988; NASA-CR-1959-Suppl) Avail: NTIS CSCL 20K

Detailed information is presented for the analytical and the experimental programs described in the report on Effects of Design Details on Structural Response to Acoustic Excitation, NASA CR-1959. This is a supplement to the basic report and detailed experimental data from all the specimens described in that report are discussed and presented in tabular form. Author

N72-12906# Aeronautical Research Labs., Melbourne (Australia).
APPROXIMATE LIFE DISTRIBUTION OF CRACKED STRUCTURES WITH RANDOM RISKS
D. G. Ford and J. M. Grandage Mar. 1971 14 p refs
(ARL/SM-Note-363) Avail: NTIS

An approximation to the average risk is found for a population of structures in which the rate of fatigue crack growth is log-normally distributed and whose strength depends only on crack length. This leads to a simple formula for probability of failure for which only the median crack growth need be known together with the relation of strength and crack length. This reliability analysis is extended to the case where there is a finite probability that there is a sudden rapid increase in crack length where the strength falls to zero. Author

N72-12907*# Stanford Univ., Calif.
DYNAMICS AND STABILITY OF MECHANICAL SYSTEMS WITH FOLLOWER FORCES
George Herrmann Washington NASA Nov. 1971 240 p refs
(Grants NGL-05-020-397; NGR-14-007-067)
(NASA-CR-1782) Avail: NTIS CSCL 13M

A monograph on problems of stability of equilibrium of mechanical systems with follower forces is presented. Concepts of stability and criteria of stability are reviewed briefly, together with means of analytical specification of follower forces. Nondissipative systems with two degrees of freedom are discussed, and destabilizing effects due to various types of dissipative forces both in discrete and continuous systems, are treated. The analyses are accompanied by some quantative experiments and observations on demonstrational laboratory models. Author

N72-12908*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMULATION OF FLIGHT MANEUVER-LOAD DISTRIBUTIONS BY UTILIZING STATIONARY, NON-GAUSSIAN RANDOM LOAD HISTORIES
Herbert A. Leybold Washington Nov. 1971 26 p refs
(NASA-TN-D-6570; L-7810) Avail: NTIS CSCL 01A

Random numbers were generated with the aid of a digital computer and transformed such that the probability density function of a discrete random load history composed of these random numbers had one of the following non-Gaussian distributions: Poisson, binomial, log-normal, Weibull, and exponential. The resulting random load histories were analyzed to determine their peak statistics and were compared with cumulative peak maneuver-load distributions for fighter and transport aircraft in flight. Author

N72-12909# Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
DESIGN DATA ON BUCKLING OF CLAMPED SKEW PLATES (ORTHOGONAL COMPONENTS). PART 2: COMBINED LOADING
Mahabaliraja and S. Durvasula Sep. 1971 96 p refs
(AE-304-S) Avail: NTIS

Buckling stress coefficients for clamped skew plates under combined loads are presented in the form of tables and interaction curves for various combinations of skew angle and aspect ratio. Analysis is based on the Galerkin method with deflection expressed as a double series of beam characteristic functions of a clamped-clamped beam. The stresses are expressed in terms of the orthogonal components. Author

N72-12910*# Michigan Univ., Ann Arbor. Dept. of Materials and Metallurgical Engineering.
TIME DEPENDENT EDGE-NOTCH SENSITIVITY OF INCONEL 718 SHEET IN THE TEMPERATURE RANGE OF 900 F-1400 F Progress Report
David J. Wilson Oct. 1971 94 p refs
(Grant NGL-23-005-005; ORA Proj. 04368)
(NASA-CR-124628; Rept-043680-18-T) Avail: NTIS CSCL 20K

Heat treatment variations of 0.030 inch thick Inconel 718 sheet were used to provide a range of mechanical characteristics and microstructural features. Tensile and creep rupture tests were conducted at temperatures from 900 to 1400 F. The microstructural features were evaluated for the as-heat treated material and for tested specimens. Results showed that the time dependent notch sensitivity of Inconel 718 could be correlated to the same mechanical characteristics and similar microstructural features as evident for Waspaloy. This would suggest even wider applicability of the results. Necessary conditions for time-dependent notch sensitivity were: (1) The notch specimen loads had to be below the approximate 0.2 percent smooth specimen offset yield strength; and (2) Test data from smooth specimens had to indicate that small amounts of creep used up large fractions of rupture life. Time dependent notch sensitivity was observed at test temperatures from 900 to 1200 F. Author

N72-12911*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BEHAVIOR OF Ti-5Al-2.5Sn ELI TITANIUM ALLOY SHEET PARENT AND WELD METAL IN THE PRESENCE OF CRACKS AT 20 K
Timothy L. Sullivan Washington Nov. 1971 31 p refs
(NASA-TN-D-6544; E-6345) Avail: NTIS CSCL 20K

Through- and surface-cracked specimens of two thicknesses were tested in uniaxial tension. Surface-cracked specimens were generally found to be stronger than through-cracked specimens with the same crack length. Apparent surface-crack fracture toughness calculated using the Anderson modified Irwin equation remained relatively constant for cracks as deep as 90 percent of the sheet thickness. Subcritical growth of surface cracks was investigated. Comparison of chamber and open air welds showed chamber welds to be slightly tougher. Both methods produced welds with toughness that compared favorably with that of the parent metal. Weld efficiencies were above 94 percent. Author

N72-12912*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VIBRATION CHARACTERISTICS OF Z-RING-STIFFENED 60 DEG CONICAL SHELL MODELS OF A PLANETARY ENTRY SPACECRAFT
Eugene C. Naumann and John S. Mixon Washington Dec. 1971 57 p refs
(NASA-TN-D-6557; L-7381) Avail: NTIS CSCL 20K

An experimental investigation of the vibration characteristics of a 60 deg conical shell model of a planetary entry vehicle is described and the results presented. Model configurations include the shell with or without one or two Z-ring stiffeners and with or without a simulated payload. Tests were conducted with the model clamped at the small diameter and with the model suspended at the simulated payload. Additionally, calculated results obtained from application of several analytical procedures reported in the literature are presented together with comparisons between experimental and calculated frequencies and meridional mode shapes. Generally, very good frequency agreement between experimental and calculated results was obtained for all model configurations. For small values of circumferential mode number, however, the frequency agreement decreased as the number of ring stiffeners increased. Overall agreement between experimental and calculated mode shapes was generally good. The calculated modes usually showed much larger curvatures in the vicinity of the rings than were observed in the experimentally measured mode shapes. Dual resonances associated with modal preference were noted for the shell without Z-ring stiffeners, whereas the addition of stiffeners produced resonances for which the model responded in two or more modes over different sections of the shell length. Author

N72-12913*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SERT 2 GIMBAL SYSTEM
Ralph J. Zavesky and Evert B. Hurst Washington Dec. 1971 29 p ref
(NASA-TM-X-2427; E-6449) Avail: NTIS CSCL 17G

The gimbal system is described that was designed to mount the thruster and to reposition the thrust vector of a mercury ion bombardment thruster through the center of gravity of the SERT 2 assembly. The SERT 2 assembly was launched 3 February 1970. The gimbal ring, gimbal mounts, bearings, actuators, and environmental testing are described. Due to the accurate alinements provided, it was not necessary to use the gimbal for the intended function. However, the gimbals were operated successfully numerous times in space after 8 months of storage. Author

N72-12914*# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center.
RESPONSE OF AEROSPACE STRUCTURES TO REENTRY AERODYNAMIC EXCITATION Final Report, 26 Jun. 1970 - 25 Oct. 1971
D. Carlin, Jr. Oct. 1971 115 p refs
(Contract NAS8-26338)
(NASA-CR-121041; HREC-6338-1; LMSC/HREC-D225410) Avail: NTIS CSCL 20K

A bibliography on aerodynamic excitation and associated structural response is presented. Very little applicable data under actual reentry conditions was found, but many wind tunnel tests and some in-flight data were. Aerodynamic excitation and proposed space shuttle configurations and reentry trajectories were studied. Attached turbulent boundary layer, separated turbulent boundary layer, and base pressure fluctuations are the region of aerodynamic excitation most applicable to exterior panels of space shuttle-type vehicles; prediction techniques are presented for these environments. Methods for predicting the response of panel structures to acoustic excitation were investigated. A normal mode approach was developed for the low frequency response and a statistical energy approach was utilized for the high frequency response. A finite element model was made of a thermal protective system test panel. Computer programs were used to determine the natural frequencies and mode shapes of the panel and to calculate the response of the panel to a reverberant acoustic field. Power spectral densities of response displacement and acceleration are presented. Author

N72-12915*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SHOCK TRANSMISSION IN COUPLED BEAMS AND RIB STIFFENED STRUCTURES Final Report
Larry D. Pope, Jerome E. Manning, and Terry D. Scharton 2 Nov. 1971 134 p refs
(Contract NAS8-21386)
(NASA-CR-121042; Rept-2091; Job-11366) Avail: NTIS CSCL 20K

Shock transmission in a simple coupled beam structure and in a ring-stringer stiffened cylinder is investigated experimentally and analytically using wave transmission and statistical energy analysis concepts. The use of the response spectrum to characterize the excitation provided to a simple beam by a force pulse is studied. Analysis of the transmission of a dilatation wave in a periodically stiffened plate indicates that the stiffeners are fairly transparent to the wave, but some of the dilatational energy is scattered into bending at each support. Author

N72-12916# Purdue Univ., Lafayette, Ind. School of Aeronautics, Astronautics and Engineering Sciences.
ELASTIC SNAP-THROUGH ANALYSIS OF CURVED PLATES USING DISCRETE ELEMENTS
T. Y. Yang Nov. 1971 33 p refs Backup document for AIAA Synoptic scheduled for publication in AIAA Journal in Apr. 1972
(AAES-71-11-11) Avail: NTIS

The geometrically nonlinear post-buckling snap-through response of plate with initial deflection subjected to lateral loads is studied using the incremental discrete-element method. The nonlinear stiffness equations of equilibrium are formulated by the use of minimum potential energy theorem. By performing first-order Taylor expansion, the equations of equilibrium are transformed into the linear incremental formulations which are appropriate for a piecewise linear incremental procedure. Based on the variation of curvature along the load-displacement curve, the load increments (both positive and negative) are chosen. In order to skip the points of maximum and minimum where the stiffness matrices are singular, a small increment of displacement is applied for one step. Formulations and procedures are demonstrated by the use of a conforming rectangular plate element with initial deflection. Static symmetrical post-buckling snap-through responses are obtained for some typical curved plates. Author

N72-12917*# Philco-Ford Corp., Newport Beach, Calif.
COMPUTER PROGRAM FOR ANALYSIS OF IMPERFECTION SENSITIVITY OF RING STIFFENED SHELLS OF REVOLUTION
Gerald A. Cohen Washington NASA Oct. 1971 195 p refs
(Contract NAS1-5554-8)
(NASA-CR-1801) Avail: NTIS CSCL 20K

A FORTRAN 4 digital computer program is presented for the initial postbuckling and imperfection sensitivity analysis of bifurcation buckling modes for ring-stiffened orthotropic multilayered shells of revolution. The boundary value problem for the second-order contribution to the buckled state was solved by the forward integration technique using the Runge-Kutta method. The effects of nonlinear prebuckling states and live pressure loadings are included. Author

N72-12918*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRUCTURAL EFFICIENCIES OF FIVE COMPRESSION PANELS WITH CURVED ELEMENTS
Gary L. Giles Washington Dec. 1971 33 p refs
(NASA-TN-D-6479; L-6546) Avail: NTIS CSCL 20K

Structural-efficiency analyses are used to determine the minimum-mass proportions of some panel configurations loaded

in uniaxial compression. Five panel constructions, four of which incorporate circular-arc elements and the other a beaded-web corrugation, are shown to have improved structural efficiencies over conventional configurations. In addition to the structural-efficiency equations, which give the mass equivalent flat-plate thickness of the panel necessary to carry a given load, related design equations for calculating the cross-sectional dimensions of these minimum-mass panels are presented. The upper and lower limits of loading, where the design constraints of minimum gage or material yield strength become the dominant design conditions, are established and the corresponding design equations which are applicable outside these limits are also presented. Author

N72-12919*# Transportation Systems Center, Cambridge, Mass.
EVALUATION OF NONDESTRUCTIVE TENSILE TESTING
J. J. Bowe and S. M. Polcari May 1971 50 p
(NASA Order NA08)
(NASA-CR-124541; DOT-TSC-NASA-71-10) Avail: NTIS CSCL 20K

The results of a series of experiments performed in the evaluation of nondestructive tensile testing of chip and wire bonds are presented. Semiconductor devices were subjected to time-temperature excursions, static-load life testing and multiple pre-stressing loads to determine the feasibility of a nondestructive tensile testing approach. The report emphasizes the importance of the breaking angle in determining the ultimate tensile strength of a wire bond, a factor not generally recognized nor implemented in such determinations. Author

N72-12920*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AUTOMATED SHELL THEORY FOR ROTATING STRUCTURES (ASTROS)
Byron J. Foster and Jerrell M. Thomas Washington Nov. 1971 327 p refs
(NASA-TN-D-6485; M-367) Avail: NTIS HC $6.00/MF $0.95 CSCL 13M

A computer program for analyzing axisymmetric shells with inertial forces caused by rotation about the shell axis is developed by revising the STARS II shell program. The basic capabilities of the STARS II shell program, such as the treatment of the branched shells, stiffened wall construction, and thermal gradients, are retained. Author

N72-12921# Pennsylvania State Univ., University Park. Materials Research Lab.
CONTACTS BETWEEN CHALCOGENIDE GLASSES, METALS AND SEMICONDUCTORS Semiannual Technical Report, 1 Jun. - 1 Dec. 1970
H. K. Henisch 1 Dec. 1970 42 p refs
(Contract DAHC04-70-C-0047; ARPA Order 1562)
(AD-878302) Avail: NTIS CSCL 20/12

The two main purposes of the research here described are to elucidate the mechanism of threshold switching and to explore new device possibilities through the use of contact materials which can be electronically altered in situ. The work has consisted of three parts: one concerned with glass film deposition on graphite and germanium substrates by flash evaporation and RF sputtering; one with pulse measurements on existing threshold switches; and one with an exploration of switching delay statistics. Author (GRA)

N72-12922# Oak Ridge National Lab., Tenn.
ANALYTICAL INVESTIGATIONS OF COMPACT REINFORCEMENT FOR RADIAL NOZZLES IN SPHERICAL SHELLS
R. C. Gwaltney and J. M. Corum 10 Feb. 1971 8 p refs
Presented at 1st Natl. Congr. on Pressure Vessels and Piping, San Francisco, 10-12 May 1971; sponsored by ASME
(Conf-710512-14; Rept-71-PVP-26) Avail: NTIS

Compact reinforcement for a series of models having single nozzles radially attached to spherical shells was examined by means of finite element analyses. Parameters studied were diameter-to-thickness ratios of the nozzles, diameter-to-thickness ratios of the spherical shells, percentage of reinforcement, outside reinforcement, inside reinforcement, and balanced reinforcement (reinforcement on both the inside and outside surfaces). The loading was internal pressure. Comparisons of theoretical predictions with experimental results are presented for one reinforced model. Twelve models were analyzed to examine the effect of compact reinforcement. Author (NSA)

N72-12923# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
MEASUREMENT OF STRESS IN PLACE Final Technical Report
Keiiti Aki Jun. 1971 10 p refs
(Contract AT(30-1)-3966)
(MIT-3966-3) Avail: NTIS

An extensive laboratory study was conducted of the mechanical response of rocks to stresses, particularly to low amplitude stress waves. Results were then applied to the field problems for the purpose of measuring the stress in the earth's crust. Author

N72-12924# California Univ., Livermore. Lawrence Radiation Lab.
MECHANICAL BEHAVIOR OF HEMISPHERICAL BILLETS OF PLASTIC-BONDED EXPLOSIVES VERTICALLY DROPPED ON A SMOOTH, RIGID, STEEL TARGET SURFACE
L. G. Green, A. M. Weston, and J. H. VanVelkinburg 25 Feb. 1971 61 p refs
(Contract W-7405-eng-48)
(UCRL-51022) Avail: NTIS

Hemispherical billets of several plastic-bonded explosives were instrumented with accelerometers and dropped from various heights to impact a smooth steel target surface. Maximum contact diameter was measured. Drop height ranged from 0.5 in. to 8 ft. Three nominal sizes of billets were dropped: (1) 6-in.-diam and 3.75 lb, (2) 11-in.-diam and 23 lb, and (3) 25.63-in.-diam and 296 lb. The measured mechanical behavior of these billets is described. Effective mechanical material properties are deduced and presented as functions of billet size and preimpact velocity (drop height). Author

N72-12925# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
PARAMETER ESTIMATION FOR THE LOG-NORMAL PARENT POPULATION OF FATIGUE FAILURES FROM A SAMPLE CONTAINING BOTH FAILED AND NON-FAILED MEMBERS
A. M. Stagg London Aeron. Res. Council 1971 48 p refs Supersedes RAE-TR-70145; ARC-32594
(ARC-CP-1144; RAE-TR-70145; ARC-32594) Avail: NTIS; HMSO: 65p; PHI: $2.75

A maximum likelihood technique was applied to provide estimates of the mean and standard deviation of the parent (log-normal) population of a sample of fatigue test results, for the case when the sample consists of some specimens that have not broken as well as specimens that have failed. The estimates produced by this method of analysis are compared with those given the application of a technique developed by Gupta and with those resulting from a graphical procedure. The samples used for these comparisons were fictitious, being obtained from an assumed parent population by a Monte Carlo technique, and, although limited in number and scope, they indicate that the maximum likelihood technique gives reasonable approximations to the population parameters. Use of the most suitable of the methods of analysis mentioned in order to correlate early service failures with a test failure should enable a check to be made on the validity of the fatigue monitoring process being applied to the service aircraft. Author (ESRO)

N72-12926# Southampton Univ. (England). Inst. of Sound and Vibration Research.
THE DYNAMIC PROPERTIES OF FIBRE REINFORCED PLASTIC BEAMS
G. C. Wright Sep. 1971 54 p refs
(ISVR-TR-51) Avail: NTIS

A single accurate method of measuring the dynamic flexural modulus and loss factor of a material is described. The method uses new ways of exciting the specimen and of measuring its displacement. Several types of composite material using glass and carbon fibers to reinforce epoxide and polyester resins were tested and the results are given. Departures from linear behavior were found and explanations for these are propounded. Author (ESRO)

N72-12927# British Steel Corp., London (England). Metallurgy Dept.
THE DETERMINATION AND APPLICABILITY OF COD (CRACK OPENING DISPLACEMENT) TEST DATA
D. Elliott Jun. 1971 17 p refs
(PB-201664; MG/S/7/71) Avail: NTIS CSCL 20K

The continuity exhibited between the linear elastic and general yielding fracture mechanics approaches has led to the adoption of a unified procedure for fracture toughness testing, in which respectively the applied force at fracture is determined and the K sub Ic calculated, or the crack tip COD is derived from clip gauge displacement measurements, using an experimental calibration procedure. Experimental results are presented to illustrate the limits to which the COD approach is confined, in an attempt to define the areas where COD can be unambiguously used. Author (GRA)

N72-12928# Naval Air Development Center, Johnsville, Pa. Aero Structure Dept.
STRESSES AND STRAINS AROUND OPEN AND FILLED HOLES IN AN ALUMINUM SHEET DURING CYCLIC LOADING Final Report
Ralph E. Vining 6 Jan. 1971 90 p refs
(Proj. I.R. TR-4-01)
(AD-726164; NADC-ST-7009) Avail: NTIS CSCL 01/3

The stress and strain history at a point of stress concentration were studied in an effort to resolve conflicts regarding the effects of spectrum block size in fatigue testing. Fatigue tests were performed using as specimens large sheets of 7075-T6 aluminum alloy with a central hole. Plastic deformation was induced at the edge of the hole, although the gross area stress in the sheet remained in the elastic range. It was found that the strains at the stress concentrator varied during subsequent constant-amplitude fatigue cycling. Relaxation of the mean stress and strain hardening were qualitatively detected. Author (GRA)

N72-12929# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
ANALYSIS OF SPACE FRAMES
Shosuke Morino and Le-Wu Lu Mar. 1971 254 p refs
(Contract N00024-69-C-5381; SF Proj. 35-422-30)
(AD-726196; FEL-331.13; NAVSHIPS-0911-000-9010-13) Avail: NTIS CSCL 13/13

The report deals with the analysis of space frames for three types of failure: plastic mechanism failure, buckling failure, and overall instability failure. The frames are assumed to be rigidly jointed and are made of material with elastic and perfectly plastic properties. All loads are proportional and their directions remain unchanged. Author (GRA)

N72-12930# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
FREQUENCY COEFFICIENTS OF A SPHERICAL SHELL FOR VARYING THICKNESS AND OPENING ANGLE, WITH GUIDED PINNED, CLAMPED AND PINNED BOUNDARY CONDITIONS
George Georgopoulos Jan. 1972 34 p refs
(Contract Nonr-486(11); NR Proj. 185-551)
(AD-728308; TR-21) Avail: NTIS CSCL 13/13

The frequency coefficients of a spherical shell are defined. The finite element method is then utilized for deriving the analogous mathematical model, and an IBM 360 computer is used for obtaining numerical results. The frequency coefficients of a spherical shell for varying thickness and opening angle, with guided clamped, guided pinned, clamped, and pinned boundary conditions are then plotted. Author (GRA)

N72-12931# Franklin Inst., Philadelphia, Pa.
A STUDY OF PRE-CRACK FATIGUE, PART 1 Final Technical Report
Melvin B. Zisfein May 1971 100 p refs
(Contract F44620-68-C-0068; AF Proj. 9782-02)
(AD-728292; FIRL-F-C2231-2; AFOSR-71-1802TR; Task-61102F; Task-681307) Avail: NTIS CSCL 20/11

The report is an examination of current technological posture in materials fatigue, especially that area of fatigue before the formation of a finite or technical crack. A computerized search of the literature was performed by the Defense Documentation Center leading to the establishment of a bibliography which was intensively examined. The various concepts and rules of fatigue damage were critically examined as were their effects on fatigue analysis. The fatigue implications of Non-Destructive Evaluation (NDE) were also reviewed with the objective of recommending new approaches. Throughout all, a number of specific recommendations for future activity were made and discussed. These are summarized at the conclusion of this report. Author (GRA)

N72-12932# Case Western Reserve Univ., Cleveland, Ohio. Div. of Metallurgy and Materials Science.
ANALYTICAL APPROACH TO COMPOSITE BEHAVIOR Summary Technical Report, 1 Mar. 1970 - 2 Mar. 1971
L. J. Ebert, R. J. Claxton, H. Kmiechiak, and P. K. Wright Wright-Patterson AFB, Ohio AFML Aug. 1971 154 p refs
(Contract F33615-67-C-1487; AF Proj. 7353)
(AD-728277; AFML-TR-71-133; Task-735301) Avail: NTIS CSCL 11/4

Additional data were acquired on the bulging of composite sheets under balanced and unbalanced biaxial tension which supported the earlier observation of increased transverse yield and fracture strengths. A biaxial yield criterion was developed which used actual stress distributions within the composite under biaxial loads as computed by a finite element technique to predict composite yielding. This criterion gave better predictions than did a Hill criterion. Fiber-matrix diffusion effects were studied in Ni-Cu cylindrical composites by subjecting composites, as well as component specimens to diffusion treatments prior to tensile testing. Experimental stress-strain behavior was compared to that predicted from the concentric cylinder analytical model with the modification that the properties of the diffusion products were included in interfacial rings. The effects of a solid solution diffusion layer on composite tensile properties was small. The macrogeometry effect on the stress-strain behavior of unidirectional composites was investigated using prototype copper-tungsten cylindrical square, and plate specimens. The uniaxial stress-strain behavior did not reveal the effect of geometry as was anticipated. In addition, strain ratio data were too inconsistent to conclude whether a geometric effect existed for the variables investigated. Author (GRA)

N72-12933# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.
THE STRESS FIELD IN A CYLINDRICALLY ANISOTROPIC BODY UNDER TWO-DIMENSIONAL SURFACE TRACTIONS Technical Report, Jun. - Dec. 1970
Nicholas J. Pagano Jun. 1971 29 p refs
(AF Proj. 7342)
(AD-728273; AFML-TR-71-122; Task-734202) Avail: NTIS CSCL 11/4

In this work, a general solution for the elastic stress field in

a cylindrically anisotropic body, the hollow circular cylinder, under surface tractions which do not vary along the generator and which can be expressed in the form of a Fourier series, is presented. The form of the solution is sufficiently general to permit direct extension to an important class of composite structures, namely, laminated circular cylinders. Some of the peculiar effects of anisotropy are illustrated by the solution of a specific boundary value problem - a circular hole in a large plate under tension. Author (GRA)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N72-12934# Army Foreign Science and Technology Center, Charlottesville, Va.

STUDY OF PROPAGATION VELOCITY OF FATIGUE CRACKS

V. I. Shabalin and G. V. Abakov 21 Jul. 1971 16 p refs Transl. into ENGLISH from Probl. Prochnosti v Mashinostr. Akad. Nauk SSSR, Inst. Mashinoved. (Moscow), no. 2, Feb. 1970 p 11-17

(AD-728532; FSTC-HT-23-732-71) Avail: NTIS CSCL 20/11

Results are presented from studies of the rate of development of cracks and the relationship of this stage of fatigue rupture to the overall durability of specimens. The rate of propagation of fatigue cracks was studied as a function of the geometric parameters of the specimen. In order to study the influence of length, specimens were made of D-16AT alloy 3 mm thick. The length of the gage (calculated) portion of the specimens was 125, 725 and 1225 mm, the width of an aperture 5 mm in diameter. Author (GRA)

N72-12935# Naval Postgraduate School, Monterey, Calif.

VIBRATION ANALYSIS OF CYLINDRICAL SHELLS BY SEVERAL FINITE DIFFERENCE SCHEMES

Robert E. Ball Jun. 1971 34 p refs

(AD-728051; NPS-57BP7161A) Avail: NTIS CSCL 20/11

Several finite differencing schemes are used to compute the natural frequencies and mode shapes of simply supported circular cylindrical shells in an attempt to determine the most accurate numerical mode. Sets of difference equations are developed from the governing differential field equations and by minimizing the finite difference form of the Lagrangian energy function. Both finite differences and trigonometric expansions are used to model the circumferential behavior. Staggered or half-stations are used in addition to the conventional differencing schemes. The results indicate that the schemes using the trigonometric expansions are generally more accurate than those using finite differences for the circumferential derivatives. Furthermore, the conventional differencing scheme is shown to be as accurate as the half-station scheme when the field equation approach is used in conjunction with the trigonometric expansions. Author (GRA)

N72-12936# Massachusetts Univ., Amherst. School of Engineering.

DESCRIPTION AND EVALUATION OF A LOADING TECHNIQUE EMPLOYING SPRINGS FOR USE IN THE TESTING OF SMALL SCALE SHELL MODELS

David C. Foster Jun. 1971 29 p

(Contract N00014-68-A-0146; NR Proj. 200-016)

(AD-728771; THEMIS-UM-71-2) Avail: NTIS CSCL 13/13

A technique for applying loads in small scale shell model studies is presented. This technique consists of a gridwork arrangement of springs attached at their upper ends to wire or string hangers that pass through small diameter holes in the shell surface and are connected to load pads resting on top of the shell surface. The lower ends of the springs are attached to a horizontal rigid plate. This plate is lowered by some suitable means, thereby transferring load from the springs, through the hangers, to the load pads and the shell surface. An evaluation of this system under use in the testing of hyperbolic paraboloid shells having both elastic and rigid boundaries is given.

Author (GRA)

N72-12937 National Lending Library for Science and Technology, Boston Spa (England).

EFFECT OF HEAT TRANSFER CONDITIONS ON THE ACCURACY OF MEASUREMENT OF A TEMPERATURE PROBE IN AIR CHANNELS

Heinz Rudolphi 19 Aug. 1971 22 p Transl. into ENGLISH from Arch. Tech. Messen (Munich), no. 397, Feb. 1969 p 25-28 and Arch. Tech. Messen (Munich), no. 398, Mar. 1969 p 51-56 (NLL-AERE-Trans-1131-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

Even at relatively low temperatures, radiative transfer of the heat of a temperature probe to the walls of the air channel can affect the accuracy of measurement adversely, especially if the probe dimensions reduce convective heat transfer in comparison with radiative heat transfer. In addition to this radiation error, heat conduction in the probe towards the colder channel wall is a source of error. This supplementary error is affected by thermal coupling of the probe or its protective tube to the wall of the channel, and by the dimensions and the material of the probe or protective tube. The coefficients of the inaccuracy caused by heat transfer are derived on the basis of the heat balance of a temperature probe, using the solution of a corresponding differential equation. Using graphs plotted for a specimen probe, the individual error factors can be evaluated and methods proposed for their reduction or elimination. Author

N72-12938# National Engineering Lab., Glasgow (Scotland). Applied Heat Transfer Div.

PRESSURE DROP, HEAT AND MASS TRANSFER DURING AIR/WATER MIST FLOW ACROSS A BANK OF TUBES

I. C. Finlay and T. McMillan Dec. 1970 30 p refs

(NEL-474) Avail: NTIS

Experimental data are reported which confirm that large increases in the heat transfer coefficient between a bank of tubes and a transverse air stream can be achieved by adding small amounts of atomized liquid to the gas stream. Resulting increases in pressure loss are found to be small by comparison, making this a potentially attractive heat transfer system. The use of an air/water mist to cool a bank of heated tubes is therefore examined. A set of differential equations is formulated, representing the simultaneous transfer of heat and mass within the system. These equations are integrated to yield the thermal design of a mist-cooled exchanger. Author

N72-12939*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

EVALUATION OF HEAT- AND BLAST-PROTECTION MATERIALS

J. D. Morrison and B. J. Lockhart Washington Nov. 1971 62 p refs

(NASA-TN-D-6484) Avail: NTIS CSCL 11C

A program was initiated at the Kennedy Space Center in December 1967 and conducted through December 1969 to evaluate the performance of heat- and blast-protection materials for ground support equipment used during the Apollo/Saturn launches. Materials believed to be generally suitable for heat and blast protection were subjected to launch-exposure tests. Tests were made during the Apollo/Saturn 502, 503, and 505 launches. Tests were also made in a local laboratory, as an alternative to the restrictive requirements of launch-exposure tests, to determine the effects of torch-flame exposure on ablative materials. Five materials were found to be satisfactory in

all major test categories. It was determined that torch-flame tests can probably be utilized as an acceptable substitute for the booster-engine-exhaust exposure tests for basic screening of candidate materials. Author

N72-12940*# New York Univ., N.Y.
LEADING EDGE COOLING BY UPSTREAM INJECTION
Renzo Piva [1971] 80 p refs
(Grant NGR-33-016-131)
(NASA-CR-111965) Avail: NTIS CSCL 20M

A leading edge cooling system by upstream along the surface was investigated. The purpose of this system is to keep the leading edge below a desired temperature without excessively increasing the radius of the tip and consequently the total pressure losses. An experimental investigation was conducted to find the optimum conditions for the cooling from the point of view of upstream jet penetration and minimum shock losses. A theoretical analysis was performed to study the flow field in the mixing region between the two counterflowing streams and the results obtained compare favorably with the experimental results. Author

N72-12941*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VACUUM AND ULTRAVIOLET RADIATION EFFECTS ON BINDERS AND PIGMENTS FOR SPACECRAFT THERMAL CONTROL COATINGS
Donald J. Progar and William R. Wade Washington Nov. 1971 42 p refs
(NASA-TN-D-6546; L-7722) Avail: NTIS CSCL 11C

An evaluation of several silicone resin binders and powdered inorganic pigments for potential use in spacecraft thermal-control paint formulations is presented. The pigments were selected on the basis of a hypothesis relating the heat of formation of a compound to the compound's resistance to ultra-radiation-induced degradation. Reflectance measurements were made in situ to determine degradation rates due to ultraviolet radiation. The tested polydimethylsiloxane resins were not significantly affected by long exposures to ultraviolet radiation. All the pigments, which were dispersed in a polydimethylsiloxane resin, were degraded by ultraviolet radiation as determined by an increase of solar absorptance. For the materials evaluated in this study, no evidence was found to indicate that pigments with high heats of formation were resistant to ultraviolet degradation. Author

N72-12942*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ANALYTICAL STUDY OF THE EFFECT OF COOLANT FLOW VARIABLES ON THE KINETIC ENERGY OUTPUT OF A COOLED TURBINE BLADE FLOW
Herman W. Prust, Jr. [1971] 18 p refs Proposed for Presentation at the 10th Aerospace Meeting, San Diego, Calif., 17-19 Jan. 1972; sponsored by AIAA
(NASA-TM-X-67960; E-6667) Avail: NTIS CSCL 20M

The results of an analytical study to determine the effect of changes in the amount, velocity, injection location, injection angle, and temperature of coolant flow on blade row performance are presented. The results show that the change in output of a cooled turbine blade row relative to the specific output of the uncooled blade row can be positive, negative, or zero. Comparisons between the analytical results and experimental results for four different cases of coolant discharge, all at a coolant temperature ratio of unity, show good agreement for three cases and rather poor agreement for the other. To further test the validity of the method, more experimental data is needed, particularly at different coolant temperature ratios. Author

N72-12943*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPORTANCE OF COMBINING CONVECTION WITH FILM COOLING
Raymond S. Colladay [1971] 11 p refs Presented at 10th Aerospace Sci. meeting, San Diego, Calif., 17-19 Jan. 1972, sponsored by AIAA
(NASA-TM-X-67962) Avail: NTIS CSCL 20M

The interaction of film and convection cooling and its effect on wall cooling efficiency is investigated analytically for two cooling schemes for advanced gas turbine applications. The two schemes are full coverage- and counterflow-film cooling. In full coverage film cooling, the cooling air issues from a large number of small discrete holes in the surface. Counterflow film cooling is a film-convection scheme with film injection from a slot geometry. The results indicate that it is beneficial to utilize as much of the cooling air heat sink as possible for convection cooling prior to ejecting it as a film. Author

N72-12944*# IIT Research Inst., Chicago, Ill.
DEVELOPMENT OF A SPACE STABLE THERMAL CONTROL COATINGS FOR USE IN LARGE SPACE VEHICLES Triannual Report, 1 May - 31 Aug 1971
J. E. Gilligan, N. A. Ashford, Y. Harada, and R. M. Leas 15 Oct. 1971 52 p refs
(Contract NAS8-26791)
(NASA-CR-121035; IITRI-C6233-8) Avail: NTIS CSCL 20M

The preparation and evaluation of zinc orthotitanate and of several new pigments and the environmental testing and evaluation of these pigments and of coatings made from them constitute the bulk of the work accomplished. New pigments were prepared and EPR spectra of pigments and their precursor compounds studied. Results of extensive testing of commercially-available, strippable, protective coatings are reported; Owens-Illinois 650 glass resin has been stabilized against progressive mechanical failures; and definite improvements have been noted. A zinc oxide pigmented lithium silicate paint has demonstrated very good ultraviolet stability. Author

N72-12945*# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
SHOCK-TUBE MEASUREMENTS OF CARBON TO OXYGEN ATOM RATIOS FOR INCIPIENT SOOT FORMATION WITH C2H2, C2H4 AND C2H6 FUELS
Samuel W. Radcliffe and John P. Appleton Mar. 1971 27 p refs
(Grant NGL-22-009-378)
(NASA-CR-124645; Publ-71-3) Avail: NTIS CSCL 21B

The critical atomic carbon to oxygen ratios, Phi sub C, for incipient soot formation in shock heated acetylene, ethylene, ethane/oxygen/ argon mixtures was measured over the temperature range 2000 K to 2500 K for reactant partial pressures between 0.1 and 0.4 atoms. Absorption of light from a He-Ne laser at 6328A was was used to detect soot. It was observed that the values of Phi sub C for all three fuels increased uniformly with temperature such that at the highest temperatures Phi sub C was considerably greater than unity, i.e. greater than the value of about unity at which solid carbon should have been precipitated on a thermochemical equilibrium basis. Observations were made over periods extending up to about one millisecond, which was well in excess of the time required for the major heat release of the combustion reactions. The relevance of these experimental findings to the problem of soot formation in gas turbine combustion chambers is discussed. Author

N72-12946*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOW-TEMPERATURE BRAYTON RADIATOR PERFORMANCE IN A VARIABLE-SINK-TEMPERATURE ENVIRONMENT
Darl B. Bien Washington Dec. 1971 18 p refs
(NASA-TM-X-2450; E-6561) Avail: NTIS CSCL 20M

An analysis of the performance of a low-temperature Brayton space radiator is presented. The cylindrical radiator with circumferential tubes was subjected to an equivalent sink temperature environment that varied along the fluid flow path.

The radiator performance, as measured by fluid outlet temperature, was found to be dependent on the orbital position and the location of the radiator inlet relative to the sink temperature environment. An approximate dynamic analysis of sun-shade variations in performance is included. Author

N72-12947*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF HEAT-TRANSFER TESTS OF AN IMPINGEMENT-CONVECTION- AND FILM-COOLED VANE IN A CASCADE
Herbert J. Gladden, Daniel J. Gauntner, and John N. B. Livingood Washington Dec. 1971 46 p refs
(NASA-TM-X-2376; E-6230) Avail: NTIS CSCL 20M

Experimental flow and heat transfer data obtained for an air-cooled turbine vane tested in a static cascade at gas temperatures and pressures to 1644 K (2500 F) and 31 N/cm2 (45 psia), respectively, are presented. Average and local vane temperatures were correlated in several ways. Calculated and measured coolant flows and vane temperatures are compared. Potential allowable increases in gas temperature are also discussed. Author

N72-12948*# National Bureau of Standards, Boulder, Colo. Inst. for Basic Standards.
STANDARD REFERENCE MATERIALS: THERMAL CONDUCTIVITY OF ELECTROLYTIC IRON, SRM 734, FROM 4 TO 300 K Final Report
J. G. Hust and L. L. Sparks Nov. 1971 24 p refs Sponsored by NASA. Lewis Res. Center, Cleveland, Ohio
(Proj. 3020585)
(NASA-CR-124622; NBS-SP-260-31) Avail: NTIS; SOD $0.35 Catalog No. C13.10:260-31 CSCL 20M

Thermal conductivity data were obtained by the axial one-dimensional heat flow method for a cylindrical rod 3.6 mm in diameter and 23 cm long with an electric heater at one end and a temperature controlled sink at the other. Variability of this iron was studied by means of electrical residual resistivity ratio measurements on 63 specimens. This study showed that with a two-hour anneal at 1000 C one can obtain a thermal conductivity Standard Reference Material that has variability of less than 1% in thermal conductivity. Author

N72-12949*# Silverstein (Calvin C.), Baltimore, Md.
A FEASIBILITY STUDY OF HEAT-PIPE-COOLED LEADING EDGES FOR HYPERSONIC CRUISE AIRCRAFT
Calvin C. Silverstein Washington NASA Nov. 1971 148 p refs
(Contract NAS1-9872)
(NASA-CR-1857; SIL-106) Avail: NTIS CSCL 20M

A theoretical study of the use of heat pipe structures for cooling the leading edges of hypersonic cruise aircraft was carried out over a Mach number range of 6 to 12. Preliminary design studies showed that a heat pipe cooling structure with a 33-in. chordwise length could maintain the maximum temperature of a 65 deg sweepback wing with a 0.5-in. leading edge radius below 1600 F during cruise at Mach 8. A few relatively minor changes in the steady-state design of the structure were found necessary to insure satisfactory cooling during the climb to cruise speed and altitude. It was concluded that heat pipe cooling is an attractive, feasible technique for limiting leading edge temperatures of hypersonic cruise aircraft. Author

N72-12950# Advisory Group for Aerospace Research and Development, Paris (France). Propulsion and Energetics Panel.
HEAT TRANSFER IN ROCKET ENGINES
H. Ziebland (Explosives Res. and Develop. Estab.) and R. C. Parkinson (Rocket Propulsion Estab.) Sep. 1971 160 p refs
(AGARD-AG-148-71; AGARDograph-148) Avail: NTIS

Basic heat transfer processes are considered: simple convective heat transfer from hot gases to the engine walls under various conditions, radiation heat transfer, and coolant heat transfer processes. Methods of cooling used in liquid propellant rocket engines, such as regenerative, film, ablation and radiation cooling are discussed. The properties of materials that must be known by the engine designer, from the transport properties of the hot combustion gases to those of the materials from which the engine will be constructed. Emphasis was placed on presenting simple methods for calculating the magnitude of heat transfer. Author

N72-12951*# Aerotherm Corp., Mountain View, Calif.
INVESTIGATION OF THERMAL PROTECTION SYSTEMS EFFECTS ON VISCID AND INVISCID FLOW FIELDS FOR MANNED ENTRY SYSTEMS Final Report, 9 Mar. - 9 Sep. 1971
Eugene P. Bartlett, Howard L. Morse, and Henry Tong 22 Sep. 1971 92 p refs
(Contract NAS9-9494; Aerotherm Proj. 6099)
(NASA-CR-115283; FR-71-38) Avail: NTIS CSCL 20M

Procedures and methods for predicting aerothermodynamic heating to delta orbiter shuttle vehicles were reviewed. A number of approximate methods were found to be adequate for large scale parameter studies, but are considered inadequate for final design calculations. It is recommended that final design calculations be based on a computer code which accounts for nonequilibrium chemistry, streamline spreading, entropy swallowing, and turbulence. It is further recommended that this code be developed with the intent that it can be directly coupled with an exact inviscid flow field calculation when the latter becomes available. A nonsimilar, equilibrium chemistry computer code (BLIMP) was used to evaluate the effects of entropy swallowing, turbulence, and various three dimensional approximations. These solutions were compared with available wind tunnel data. It was found study that, for wind tunnel conditions, the effect of entropy swallowing and three dimensionality are small for laminar boundary layers but entropy swallowing causes a significant increase in turbulent heat transfer. However, it is noted that even small effects (say, 10-20%) may be important for the shuttle reusability concept. Author

N72-12952# National Bureau of Standards, Washington, D.C. Physical Chemistry Div.
SELECTED VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES: TABLES FOR THE ALKALINE EARTH ELEMENTS (ELEMENTS 92 THROUGH 97 IN THE STANDARD ORDER OF ARRANGEMENT)
V. B. Parker, D. D. Wagman, and W. H. Evans Nov. 1971 120 p
(NBS-TN-270-6) Avail: SOD $1.25 Catalogue No. C 13.46:270-6

Tables of values for the standard heats and Gibbs (free) energies of formation, entropies and enthalpies at 298.15 K and heats of formation at 0 K for compounds of beryllium, magnesium, calcium, strontium, barium, and radium (elements 92-97 in the standard order of arrangement) are given. Author

N72-12953*# General Dynamics/Convair, San Diego, Calif.
COMPUTATIONAL TECHNIQUES FOR DESIGN OPTIMIZATION OF THERMAL PROTECTION SYSTEMS FOR THE SPACE SHUTTLE VEHICLE. VOLUME 1: FINAL REPORT
30 Sep. 1971 189 p refs 2 Vol.
(Contract NAS9-10956)
(NASA-CR-115242; GDCA-DDB71-005-Vol-1) Avail: NTIS CSCL 20M

Computational techniques were developed and assimilated for the design optimization. The resulting computer program was then used to perform initial optimization and sensitivity studies on a typical thermal protection system (TPS) to demonstrate its application to the space shuttle TPS design. The program was developed in Fortran IV for the CDC 6400 but was subsequently converted to the Fortran V language to be used on the Univac 1108. The program allows for improvement and update of the performance prediction techniques. The program logic involves

subroutines which handle the following basic functions: (1) a driver which calls for input, output, and communication between program and user and between the subroutines themselves; (2) thermodynamic analysis; (3) thermal stress analysis; (4) acoustic fatigue analysis; and (5) weights/cost analysis. In addition, a system total cost is predicted based on system weight and historical cost data of similar systems. Two basic types of input are provided, both of which are based on trajectory data. These are vehicle attitude (altitude, velocity, and angles of attack and sideslip), for external heat and pressure loads calculation, and heating rates and pressure loads as a function of time. Author

N72-12954*# General Dynamics/Convair, San Diego, Calif.
COMPUTATIONAL TECHNIQUES FOR DESIGN OPTIMIZATION OF THERMAL PROTECTIVE SYSTEMS FOR THE SPACE SHUTTLE VEHICLE. VOLUME 2: USER'S MANUAL
30 Sep. 1971 134 p 2 Vol.
(Contract NAS9-10956)
(NASA-CR-115241; GDCA-DDB71-005-Vol-2) Avail: NTIS CSCL 20M

A modular program for design optimization of thermal protection systems is discussed. Its capabilities and limitations are reviewed. Instructions for the operation of the program, output, and the program itself are given. K.P.D.

N72-12955# Joint Publications Research Service, Washington, D.C.
SOME FEATURES OF HEAT TRANSFER IN POROUS MEDIA
Ye. A. Maksimov and M. V. Stradomskiy 18 Nov. 1971 5 p refs Transl. into ENGLISH from Inzn.-Fiz. Zh. (Moscow), v. 20, no. 4, 14 Apr. 1970 p 588-591
(JPRS-54515; UDC-536.24:532.546) Avail: NTIS

The analysis of differential equations for the temperature of a coolant flowing in a heated wall and the wall temperature shows that the dependence of heat transfer inside the pores with constant wall geometry may be described by the relationship Nu = f(Pe). The experimental study carried out when porous material was cooled with air, nitrogen, liquid ethyl alcohol and transformer oil with no phase transitions confirms satisfactorily the results obtained from the analysis of differential equations. Author

N72-12956# Union Carbide Corp., Indianapolis, Ind. Linde Div.
RESEARCH AND DEVELOPMENT IN A THERMAL INSULATION STUDY, PHASE 1, 28 MARCH 1966 - 27 SEPTEMBER 1967 Final Report
W. D. DeWitt, N. C. Gibbon, R. L. Reid, and D. J. Webster 11 Dec. 1970 389 p refs Revised
(Contract AT(30-1)-3632)
(ALO-3632-20-Rev-1) Avail: NTIS HC $6.00/MF $0.95

The insulation systems studied were the multi-foil type in which reflective radiation shields are separated by low thermal conductivity spacers. For a composite insulation system operating between ambient and 1800 F with a life of 1 to 5 years the following radiation shield materials; aluminum, copper, and nickel were recommended. Tantalum foil, selected as an alternate for nickel, was rejected because of incompatibility with silica fiber spacers. Glass fiber paper, aluminum flake opacified glass fiber paper, Refrasil quartz fiber paper, copper flake opacified Refrasil quartz fiber paper, and Astroquartz cloth were the spacer materials evaluated. Thermal conductivity as a function of temperature was determined for selected combinations of the foils and spacers and the low thermal conductivities anticipated were experimentally verified. During 2000 hour thermal stability tests of selected insulation combinations the only combination displaying thermal degradation was tantalum foil-Astroquartz cloth. This was attributed to the formation of high emissivity compounds of tantalum. Author (NSA)

N72-12957# Royal Aircraft Establishment, Farnborough (England). Engineering Physics Dept.
ON THE SPONTANEOUS IGNITION TEMPERATURE OF ORGANIC MATERIALS IN OXYGEN
Hilda C. Attwood and G. R. Allen London Aeron. Res. Council 1971 36 p refs Supersedes RAE-TR-70083: ARC-32376 (ARC-CP-1172; RAE-TR-70083; ARC-32376) Avail: NTIS HMSO: 50 p; PHI: $2.25

Doubts have been expressed on the significance of the current 'bomb' and 'pot' tests used to measure the spontaneous ignition temperature of organic materials in high and low pressure oxygen. An investigation of how to explore some of these doubts and to test new materials is described, and the results are discussed. Suggestions are made for improved 'bomb' and 'pot' test procedures, and for investigations into the basic nature of ignition processes and the relationship between laboratory tests and field conditions. Author (ESRO)

N72-12958# Naval Weapons Lab., Dahlgren, Va.
AN INVESTIGATION OF THE HYDRODYNAMIC AND HYDROSTATIC EFFECTS ON CARTRIDGE ACTUATED DEVICES
J. Miller, Jr. and John Sun Apr. 1971 68 p refs
(AD-726167; NWL-TR-2560) Avail: NTIS CSCL 19/1

A generalized set of differential equations was derived for modeling the interior ballistics of cartridge actuated devices in the hydrosphere. Hydrodynamic drag, hydrostatic pressure, buoyancy and cavitation are discussed. The hydrodynamic and hydrostatic forces acting on an underwater cartridge actuated device are explored by means of an interior ballistic model programmed on an analog computer. The computer results and computer program are included. The relative effects of hydrodynamic and hydrostatic forces on the performance of the device and the limiting operational depth of the device are indicated by the solutions of the model. Author (GRA)

N72-12959# North Carolina State Univ., Raleigh.
STUDIES IN THE DYNAMICS OF VISCOUS FLUIDS CONDUCTING HEAT
Yasuyuki Horie Jun. 1971 48 p refs
(Contract N00014-68-A-0187; NR Proj. 064-504)
(AD-726188; TR-71-3) Avail: NTIS CSCL 20/13

Problem solutions for non-ideal compressible fluids are known to be singular when the coefficients of viscosity and thermal conduction approach zero. The solutions of ideal fluids may not be recovered from the non-ideal solutions. Introducing a simple physical idea that non-equilibrium effects are explicity time-dependent, the treatment formulates non-ideal fluids which show no such effects. Applications are made to four simple cases which may be analyzed by elementary means: characteristics motions, dispersion relations, plane shocks of steady profile, and Rayleigh's flat plate problem. The major results involve a demonstration that asymptotic paradoxes appear when non-commutable limit operations are violated, the existence of a thermodynamical stability criterion of fluid flows, the equivalence of Rayleigh's problem to a transmission line problem, and a new interpretation of the Rayleigh line for viscous shock-structures. Author (GRA)

N72-12960# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
STEFAN'S PROBLEM
S. L. Kamenomostkaya 1971 40 p refs Transl. into ENGLISH from Mat. Sb. (Moscow), v. 53, no. 4, 1961 p 489-514
(AD-725877; CRREL-TL282) Avail: NTIS CSCL 20/13

In the present work Stefan's problem in its general sense (multidimensional case, arbitrary number of initially unknown phase boundary surfaces, a thermal coefficient dependence of the phase on temperature) is analyzed. A determination of the general solution of the problem is introduced and it is shown, that the classical solution of the problem is general (theorem 1). Using the method of finite differences the existence of solutions of the edge problem and the Cauchy problem are shown for an arbitrary segment of time. The uniqueness of the general solution is shown, from which in particular follows the uniqueness of the classical solution. Author (GRA)

N72-12961# Army Foreign Science and Technology Center, Charlottesville, Va.
TRANSFORMING THERMODYNAMIC EQUATIONS
D. P. Kolodnyi 30 Jun. 1971 13 p refs Transl. into ENGLISH from Inzh. Fiz. Zh., Akad. Nauk Belorussk. SSR (Minsk), v. 17, no. 6, 1969
(AD-728534; FSTC-HT-23-984-71) Avail: NTIS CSCL 20/13

The author applies a code to transform thermodynamic equations by substituting different thermodynamic variables.
Author (GRA)

N72-12962# Naval Ordnance Lab., White Oak, Md.
THE DISTRIBUTION AND HISTORY OF TEMPERATURE IN CIRCULAR CYLINDERS EXPOSED TO THE THERMAL RADIATION PULSE OF A NUCLEAR DETONATION
Donald M. Wilson 14 Jun. 1971 135 p refs
(SF Proj. 26-553-001-11292)
(AD-728751; NOLTR-71-61) Avail: NTIS CSCL 18/3

Temperature distribution histories were calculated in detail for cylinders exposed to the thermal radiation pulse from a low altitude nuclear weapon detonation. Results are presented in terms of dimensionless groups and charts covering a wide range of the parameters - weapon yield, radiant exposure, cylinder wall thickness, outer radius, and material. The temperatures are for circular cylinders whose absorbance, thermal conductivity, density and specific heat are constant with temperature and time. The effect of convective cooling on maximum temperature is considered separately and shown to be small for cylinders of practical application and was not used in the dimensionless presentations. The dimensionless charts of this report can be used to determine temperatures in cylindrical structural elements exposed to the thermal radiation pulse. This report shows what effect the changes in cylinder or weapon parameters have on the manner in which temperature is distributed in cylinders. The rear half of a cylinder exposed to a nuclear weapon thermal radiation pulse is unheated and the front half is heated in a spatially non-uniform manner. Therefore, internal heat conduction and the resultant temperature distribution histories in cylinders are more complex than for simpler elements such as flat plates. The influence of parameter changes on the internal heat transfer and the resulting temperature distributions and histories will be discussed to give insight into the selection of cylindrical elements to withstand a nuclear weapons attack. Author (GRA)

N72-12171# Joint Publications Research Service, Washington, D.C.
THERMAL REGIME AND HEAT REGULATING SYSTEM
I. A. Yelenov, A. M. Rybin, and A. S. Yakovlev *In its* Lunokhod-1: Mobile Lunar Lab. 22 Nov. 1971 p 41-46 (See N72-12168 03-11)
Avail: NTIS

34 GENERAL

Includes information of a broad nature related in industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents.

N72-12963*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
METHODOLOGIES FOR OPTIMAL RESOURCE ALLOCATION TO THE NATIONAL SPACE PROGRAM AND NEW SPACE UTILIZATIONS. VOLUME 1: TECHNICAL DESCRIPTION Final Report
19 Nov. 1971 110 p refs
(Contract NAS2-5202)
(NASA-CR-114380) Avail: NTIS CSCL 22A

The optimal allocation of resources to the national space program over an extended time period requires the solution of a large combinatorial problem in which the program elements are interdependent. The computer model uses an accelerated search technique to solve this problem. The model contains a large number of options selectable by the user to provide flexible input and a broad range of output for use in sensitivity analyses of all entering elements. Examples of these options are budget smoothing under varied appropriation levels, entry of inflation and discount effects, and probabilistic output which provides quantified degrees of certainty that program costs will remain within planned budget. Criteria and related analytic procedures were established for identifying potential new space program directions. Used in combination with the optimal resource allocation model, new space applications can be analyzed in realistic perspective, including the advantage gain from existing space program plant and on-going programs such as the space transportation system.
Author

N72-12964*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
METHODOLOGIES FOR OPTIMAL RESOURCE ALLOCATION TO THE NATIONAL SPACE PROGRAM AND NEW SPACE UTILIZATIONS. VOLUME 2: RESOURCE ALLOCATION AND SMOOTHING MODEL, PROGRAMMER'S MANUAL Final Report
19 Nov. 1971 190 p refs
(Contract NAS2-5202)
(NASA-CR-114381) Avail: NTIS CSCL 22A

Appendixes are presented that provide model input requirements, a sample case, flow charts, and a program listing. At the beginning of each appendix, descriptive details and technical comments are provided to indicate any special instructions applicable to the use of that appendix. In addition, the program listing includes comment cards that state the purpose of each subroutine in the complete program and describe operations performed within that subroutine. The input requirements includes details on the many options that adapt the program to the specific needs of the analyst for a particular problem.
Author

N72-12965# National Academy of Sciences-National Research Council, Washington, D.C.
UNITED STATES SPACE SCIENCE PROGRAM
1971 160 p refs Presented at the 14th COSPAR meeting, Seattle, Jun. 1971
Avail: NTIS

This report on the United States space program is compiled from the contributions of many organizations and individuals. It includes summaries of observations from spacecraft, sounding rockets, high-altitude balloons and in some cases, aircraft, that were made during 1970 or reported in 1970, and it briefly discusses flights planned for 1971. Laboratory work and ground-based observations are not reported unless they specifically relate to a particular flight experiment or program. In addition to the accounts on space research, grouped under the relevant scientific disciplines, three chapters contain information on technological development, cooperative international activities, and organizational changes bearing on space research during the year.
Author

N72-12966*# Denver Univ., Colo. Industrial Economics Div.
APPLICATIONS OF AEROSPACE TECHNOLOGY IN INDUSTRY, A TECHNOLOGY TRANSFER PROFILE: FIRE SAFETY
James P. Kottenstette, James E. Freeman, Conrad R. Heins, William M. Hildred, F. Douglas Johnson, and Eileen R. Staskin Jul. 1971 74 p refs
(Grant NSR-06-004-063)
(NASA-CR-123420) Avail: NTIS CSCL 13L

The fire safety field is considered as being composed of three parts: an industry, a technology base, and a user base. An overview of the field is presented, including a perspective on the magnitude of the national fire safety problem. Selected NASA contributions to the technology of fire safety are considered.

Communication mechanisms, particularly conferences and publications, used by NASA to alert the community to new developments in the fire safety field, are reviewed. Several examples of nonaerospace applications of NASA-generated fire safety technology are also presented. Issues associated with attempts to transfer this technology from the space program to other sectors of the American economy are outlined. Author

N72-12967# Committee on Science and Astronautics (U. S. House).
FOR THE BENEFIT OF ALL MANKIND: A SURVEY OF THE PRACTICAL RETURN FROM SPACE INVESTMENT
Philip P. Dickinson, comp. Washington GPO 1971 88 p refs
Presented by the Comm. on Sci. and astronaut. to Comm. of the Whole House on the State of the Union at the 92d Congr., 1st Sess., 14 Dec. 1971 Revised
(H-Rept-92-748; Union-Calendar-368; Serial-L) Avail: US Capitol, House Document Room

The benefits derived from the space program are discussed. In accordance with the provisions of the original Space Act, efforts have been successful in the expansion of human knowledge, long range studies of the potential benefits to be gained, and the utilization of aeronautical and space activities for peaceful and scientific purposes. Areas of activity discussed are: (1) communications, (2) weather forecasting, (3) agriculture, (4) management, (5) education, and (6) aeronautics. Author

N72-12968# Federal Aviation Administration, Washington, D.C.
FAA STATISTICAL HANDBOOK OF AVIATION
1970 310 p refs
(ZMS-348G; FAS-1; FFS-1; FFS-2; FFS-3; FFS-5; FFS-7; FAT-O(Minimum)) Avail: SOD $2.75 Stock No. 5007-0166

A handbook of aviation historical data is presented to assist in evaluating progress, determine trends, and estimating future aeronautical activity. Data on major civil aviation activities for the 11-year period ending 31 December 1969 are reported, and include the following areas: (1) FAA and its functions, (2) workload of FAA air traffic facilities, (3) airport activity statistics, (4) U.S. civil air carrier operating data, (5) general aviation aircraft, and (6) aircraft accidents. F.O.S.

N72-12969# Federal Aviation Administration, Washington, D.C.
THIRD ANNUAL NATIONAL AVIATION SYSTEM PLANNING REVIEW CONFERENCE
1971 74 p refs Conf. held 26-29 Apr. 1971
(WRCNM-2; FOF-O(Minimum)) Avail: NTIS

Summaries of the lectures presented at the annual forum are presented along with summaries of the group discussions. The sessions reported include: plenary session, capital equipment priorities and investments, man in the system, systems engineering management, research and development, and short haul transportation. F.O.S.

N72-12970# Department of Transportation, Washington, D.C.
A STATEMENT ON NATIONAL TRANSPORTATION POLICY
John Volpe 1971 63 p refs
Avail: NTIS

The impact of national transportation policy on the American economy and society are reviewed. Topics discussed include: status of transportation, Federal role, problems of the transportation sector, existing policies, transportation objectives, and new directions in transportation policies. F.O.S.

N72-12971# Aeronautical Research Council (Gt. Brit.).
PUBLISHED REPORTS AND MEMORANDA OF THE AERONAUTICAL RESEARCH COUNCIL (NOS. 3551 TO 3650)
1971 13 p refs
(ARC-R and M-3650) Avail: NTIS

One hundred titles which have been published in the R/M Series of the Aeronautical Research Council are listed. They include reports on aerodynamics, aircraft, wind tunnel tests, etc. Author (ESRO)

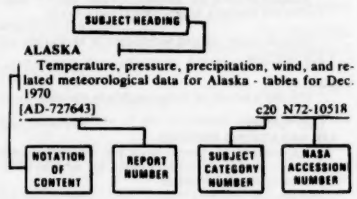
N72-12972# Office of Naval Research, London (England).
AERONAUTICAL ENGINEERING AT TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY
Richard D. Mathieu 4 Jun. 1971 23 p refs
(AD-726162; ONRL-R-15-71) Avail: NTIS CSCL 05/9

The shortage of engineers in Israel and the role that the Technion - Israel Institute of Technology plays in the education of engineers is discussed. Emphasis is placed on the academic program, research, and related activities in the Department of Aeronautical Engineering. Author (GRA)

N72-12250*# Geological Survey, Washington, D.C.
CENSUS CITIES PROJECT AND ATLAS OF URBAN AND REGIONAL CHANGE
James R. Wray *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 16 p (See N72-12248 03-13)
Avail: NTIS CSCL 05K

SUBJECT INDEX

TYPICAL SUBJECT INDEX LISTING



The subject heading is a key to the subject content of the document. The Notation of Content (NOC), rather than the title of the document, is used to provide a more exact description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The subject category number indicates the subject category in the abstract section in which the citation is located. The NASA accession number denotes the number by which the citation is identified within the subject category. The NOC's are arranged under each subject heading in ascending accession number order.

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Dourbes [Belgium] Geophysical Observatory data on geomagnetism, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during Feb. 1971
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Dourbes [Belgium] geophysical observatory data on geomagnetism, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during Jan. 1971
c13 N72-12354
Dourbes [Belgium] geophysical observatory data on geomagnetism, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during Dec. 1970
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Ionospheric sounding and cosmic ray neutron flux density tables. Dourbes, Belgium, May 1971
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[NASA-TT-F-14064] c04 N72-12023
Optical satellite tracking of Cosmos and other artificial satellites, Edinburgh, Jun. 1971
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[NASA-TM-X-2425] c22 N72-12604

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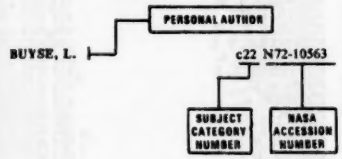

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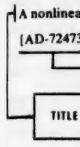

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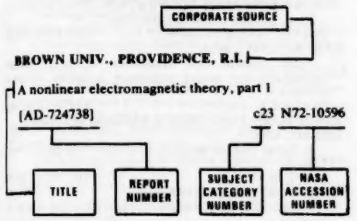

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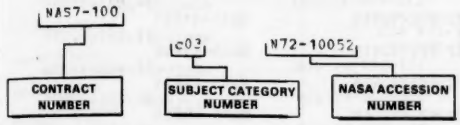

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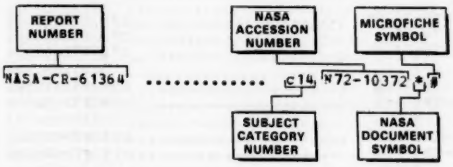

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AERE-R-6812 ..... c11 N72-12196 #

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AFETR-TR-71-2 ..... c20 N72-12558 #

AFFDL-TR-70-98 ..... c23 N72-12661 #
AFFDL-TR-71-3 ..... c02 N72-11969 #
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AFGWC-TN-71-1 ..... c20 N72-12562 #
AFGWC-TN-71-2 ..... c20 N72-12561 #

AFHRL-TR-70-45 ..... c05 N72-12062 #
AFHRL-TR-71-4 ..... c05 N72-12064 #

AFML-TR-71-47 ..... c17 N72-12482 #
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AFML-TR-71-81 ..... c17 N72-12483 #
AFML-TR-71-95 ..... c15 N72-12430 #
AFML-TR-71-104 ..... c17 N72-12478 #
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AFOSR-70-2403TR ..... c16 N72-12450 #
AFOSR-71-0713-TR ..... c04 N72-12031 #
AFOSR-71-1165TR ..... c12 N72-12234 #
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AFOSR-71-1984TR ..... c04 N72-12030 #
AFOSR-71-2040TR ..... c23 N72-12670 #
AFOSR-71-2166TR ..... c07 N72-12105 #
AFOSR-71-2176TR ..... c19 N72-12538 #
AFOSR-71-2178TR ..... c12 N72-12237 #
AFOSR-71-2183TR ..... c01 N72-11913 #
AFOSR-71-2196TR ..... c07 N72-12107 #
AFOSR-71-2203TR ..... c13 N72-12365 #
AFOSR-71-2204TR ..... c12 N72-12238 #
AFOSR-71-2205TR ..... c10 N72-12160 #
AFOSR-71-2213TR ..... c13 N72-12366 #
AFOSR-71-2262TR ..... c04 N72-12037 #
AFOSR-71-2266TR ..... c02 N72-11973 #

AFRPL-TR-71-77 ..... c08 N72-12130 #

AGARD-AG-148-71 ..... c33 N72-12950 #

AGARD-AR-37-71 ..... c11 N72-12162 #

AGARD-CONF-PROC-63 ..... c18 N72-12492 #

AGARD-CP-63-71 ..... c18 N72-12492 #
AGARD-CP-83-71 ..... c01 N72-11854 #
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AGARD-LS-45-71 ..... c31 N72-12861 #

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AR-1 ..... c13 N72-12365 #

ARA-8G80-F ..... c31 N72-12902 #
ARA-12 ..... c01 N72-11906 #

ARC-CP-1131 ..... c01 N72-11906 #
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ARC-CP-1145 ..... c01 N72-11903 #
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ARC-CP-1148 ..... c01 N72-11905 #
ARC-CP-1151 ..... c02 N72-11960 #
ARC-CP-1152 ..... c02 N72-11961 #
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ARC-CP-1159 ..... c20 N72-12554 #
ARC-CP-1162 ..... c14 N72-12392 #
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ARO-VKF-TR-71-39 ..... c12 N72-12235 #

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AROD-6858-6-E ..... c12 N72-12242 #
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AS-71-3 ..... c12 N72-12238 #

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AVSD-0429-71-RR ..... c31 N72-12880*#

B-90000/1CR-14 ..... c07 N72-12102 #

BA-145A ..... c21 N72-12576*#

BARC-543 ..... c11 N72-12189 #

BDX-613-341 ..... c18 N72-12517 #
BDX-613-407 ..... c06 N72-12073 #

BN-698 ..... c25 N72-12754 #
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BPSN-64-6805-7353-735303 ..... c17 N72-12483 #

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CAL-RM-2731-A-1 ..... c12 N72-12207*#

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CEA-N-1241 ..... c22 N72-12616 #
CEA-N-1367 ..... c22 N72-12608 #
CEA-N-1390 ..... c24 N72-12729 #
CEA-N-1436 ..... c22 N72-12614 #

CEA-R-4089 ..... c06 N72-12074 #
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CERN-TRANS-71-7 ..... c11 N72-12188 #
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CONF-700806-61 ..... c24 N72-12698 #
CONF-700945-2 ..... c10 N72-12159 #
CONF-701121-6 ..... c11 N72-12193 #
CONF-710109-1 ..... c22 N72-12618 #
CONF-710301-6 ..... c24 N72-12717 #
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CONF-710602-1 ..... c17 N72-12471 #
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CONV-69-34-412-00-480-75-01 ..... c02 N72-11944*#

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COO-1760-4 ..... c24 N72-12692 #
COO-1764-120 ..... c24 N72-12703 #

CRREL-TL282 ..... c33 N72-12960 #

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CRSR-454 ..... c06 N72-12068*#
CRSR-455 ..... c30 N72-12837*#
CRSR-456 ..... c30 N72-12835*#

CSO-0267/72-S ..... c12 N72-12218 #
CSO-0291/72-W ..... c24 N72-12679 #
CSO-0634/72-S ..... c11 N72-12167 #
CSO-0929/72-W ..... c13 N72-12334 #
CSO-1850-S ..... c05 N72-12057 #
CSO-1850-S ..... c05 N72-12058 #
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CSO-1866-W ..... c30 N72-12839 #

CW-WR-69-072.F ..... c28 N72-12795 #

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D-60 ..... c21 N72-12592 #
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D-112 ..... c25 N72-12737 #

DAC-60538-F ..... c04 N72-12035 #

DASA-SUBTASK-NA-002/20 ..... c12 N72-12239 #

DASA-2166-2-VOL-2 ..... c24 N72-12727 #

DC-71-4 ..... c12 N72-12210*#

DDAD-EDR-7035 ..... c17 N72-12482 #

DIA-TASK-T65-04-18A ..... c28 N72-12800 #

DK-551.578.46:551.574.42:656.1 .... c20 N72-12545 #

DLR-FB-71-18 ..... c12 N72-12231 #
DLR-FB-71-21 ..... c25 N72-12757 #

DME/NAE-1971(3) ..... c30 N72-12820 #

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DMS-DR-1167 ..... c31 N72-12877*#
DMS-DR-1177-VOL-1 ..... c31 N72-12878*#
DMS-DR-1177-VOL-3 ..... c31 N72-12895*#
DMS-DR-1186 ..... c31 N72-12860*#

DOD-ELEMENT-61102F ..... c25 N72-12761 #
DOD-ELEMENT-61102H ..... c09 N72-12149 #
DOD-ELEMENT-62301D ..... c30 N72-12857*#

DOD-SUBELEMENT-689-20G-5520 ..... c09 N72-12149 #
DOD-SUBELEMENT-681301 ..... c25 N72-12761 #

DOT-TSC-NASA-71-10 ..... c32 N72-12919*#

DR-1851 ..... c06 N72-12072 #
DR-1876 ..... c24 N72-12700 #

DSPEB-33 ..... c21 N72-12595 #

D6-25492 ..... c02 N72-11957*#
D180-10302-2 ..... c03 N72-11987*#
D203613-007 ..... c04 N72-12012*#

E-2606 ..... c21 N72-12589*#
E-5617 ..... c13 N72-12327*#
E-5877 ..... c12 N72-12219*#
E-5973 ..... c01 N72-11888*#
E-6191 ..... c28 N72-12785*#
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E-6373 ..... c28 N72-12780*#
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E-6470 ..... c17 N72-12468*#
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E-6477 ..... c30 N72-12833*#
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E-6496 ..... c12 N72-12216*#
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E-6671 ..... c28 N72-12783*#
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E-6678 ..... c22 N72-12599*#
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ECOM-0021-F ..... c16 N72-12451 #
ECOM-0238-2 ..... c09 N72-12146 #
ECOM-0325-F ..... c09 N72-12153 #
ECOM-5365 ..... c31 N72-12903 #

ECR-22 ..... c07 N72-12098 #
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EE-4012-113-71U ..... c26 N72-12769*#

EF/TN/A/41 ..... c12 N72-12203 #

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ESD-TR-71-11 ..... c21 N72-12594 #

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ESL-2768-6 ..... c07 N72-12105 #

ESRO-CR-27 ..... c28 N72-12794 #

ESRO-SP-51 ..... c12 N72-12230 #

EUR-CEA-FC-591 ..... c25 N72-12748 #
EUR-CEA-FC-595 ..... c25 N72-12745 #

EURFNR-852 ..... c22 N72-12613 #

EXPT-S065-APOLLO-9 ..... c14 N72-12398*#

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FAA-NA-71-7 ..... c07 N72-12087 #
FAA-NA-71-32 ..... c02 N72-11947 #
FAA-NA-71-42 ..... c21 N72-12578 #

FAA-RD-71-58 ..... c02 N72-11940 #
FAA-RD-71-73 ..... c02 N72-11946 #
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FAMOS-TN-2-71 ..... c31 N72-12902 #

FAS-1 ..... c34 N72-12968 #

FAT-0(MINIMUM) ..... c34 N72-12968 #

FEI-192 ..... c24 N72-12716 #

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FHR-4000 ..... c12 N72-12202*#

FIRL-F-C2231-2 ..... c32 N72-12931 #

FOF-0(MINIMUM) ..... c34 N72-12969 #

FR-71-38 ..... c33 N72-12951*#

FSTC-HT-23-429-70 ..... c17 N72-12484 #
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FSTC-HT-23-515-71 ..... c18 N72-12522 #
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FSTC-HT-23-732-71 ..... c32 N72-12934 #
FSTC-HT-23-733-71 ..... c17 N72-12488 #
FSTC-HT-23-741-71 ..... c02 N72-11970 #
FSTC-HT-23-880-71 ..... c08 N72-12131 #
FSTC-HT-23-984-71 ..... c33 N72-12961 #

FTD-MT-24-6-71 ..... c28 N72-12800 #

FTI-129 ..... c11 N72-12188 #
FTI-130 ..... c11 N72-12190 #

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G-181-F ..... c07 N72-12082*#
G-1026 ..... c23 N72-12631*#
G-1029 ..... c03 N72-11986*#
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G-1033 ..... c31 N72-12883*#

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GDCA-DDB71-005-VOL-1 ..... c33 N72-12953*#
GDCA-DDB71-005-VOL-2 ..... c33 N72-12954*#

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GESP-519 ..... c03 N72-11978*#
GESP-610 ..... c17 N72-12458*#
GESP-7047 ..... c22 N72-12606*#

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H-520 ..... c01 N72-11900*#
H-651 ..... c05 N72-12059*#

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HDL-TM-70-30 ..... c12 N72-12241 #

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HDL-TR-1561 ..... c09 N72-12148 #

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HIT-487 ..... c13 N72-12342*#

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IDA/HQ-71-12373 ..... c23 N72-12666 #

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IFVE-SKU-70-57 ..... c11 N72-12191 #
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IITRI-C6233-8 ..... c33 N72-12944*#

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INR-1273 ..... c09 N72-12144 #
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IR-USGS-220 ..... c13 N72-12330*#

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ITEF-784 ..... c24 N72-12720 #
ITEF-813 ..... c24 N72-12691 #

ITF-70-99 ..... c24 N72-12707 #
ITF-71-12-P ..... c24 N72-12715 #
ITF-71-28-E ..... c24 N72-12708 #

ITR-3 ..... c12 N72-12242 #

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JANAIR-701221-VOL-3 ..... c02 N72-11974 #

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JINR-E4-5837 ..... c24 N72-12704 #
JINR-E13-5796 ..... c24 N72-12693 #
JINR-E15-5800 ..... c30 N72-12851 #

JINR-P2-5765 ..... c24 N72-12706 #
JINR-P2-5829 ..... c24 N72-12709 #
JINR-P6-5794 ..... c24 N72-12728 #
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JINR-P9-5753 ..... c09 N72-12145 #
JINR-P13-5793 ..... c10 N72-12156 #

JOB-11366 ..... c32 N72-12915*#

JPL-TM-33-504 ..... c22 N72-12605*#
JPL-TM-33-505 ..... c14 N72-12386*#
JPL-TM-33-506 ..... c28 N72-12791*#
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JPL-TM-33-510 ..... c28 N72-12792*#
JPL-TM-33-516 ..... c08 N72-12117*#
JPL-TM-33-518 ..... c07 N72-12093*#

JPL-TR-32-1526-VOL-6 ..... c30 N72-12845*#

JPRS-54355 ..... c05 N72-12039 #
JPRS-54378 ..... c31 N72-12889 #
JPRS-54386 ..... c15 N72-12415 #
JPRS-54396 ..... c04 N72-11989 #
JPRS-54401 ..... c20 N72-12548 #
JPRS-54423 ..... c12 N72-12218 #
JPRS-54439 ..... c24 N72-12681 #
JPRS-54440 ..... c24 N72-12679 #
JPRS-54479 ..... c11 N72-12167 #
JPRS-54481 ..... c30 N72-12839 #
JPRS-54493 ..... c05 N72-12057 #
JPRS-54502 ..... c13 N72-12334 #
JPRS-54505 ..... c07 N72-12091 #
JPRS-54515 ..... c33 N72-12955 #
JPRS-54525 ..... c11 N72-12168 #
JPRS-54531 ..... c05 N72-12058 #
JPRS-54577 ..... c30 N72-12848 #
JPRS-54590 ..... c30 N72-12850 #
JPRS-54619 ..... c25 N72-12744 #
JPRS-54621 ..... c29 N72-12809 #
JPRS-54622 ..... c13 N72-12344 #

JUL-734-FF ..... c19 N72-12535 #

K-920833-5 ..... c25 N72-12760 #

KFK-1261 ..... c22 N72-12613 #

KGO-713 ..... c14 N72-12381 #

KHFTI-70-30 ..... c09 N72-12143 #

KSC-TR-1130 ..... c12 N72-12210*#

KTH-AERO-FL-301 ..... c30 N72-12856 #

L-6546 ..... c32 N72-12918*#
L-7054 ..... c02 N72-11948*#
L-7381 ..... c32 N72-12912*#
L-7722 ..... c33 N72-12941*#
L-7770 ..... c19 N72-12526*#
L-7810 ..... c32 N72-12908*#
L-7843 ..... c02 N72-11956*#
L-7913 ..... c01 N72-11853*#
L-7914 ..... c01 N72-11896*#
L-7932 ..... c25 N72-12743*#
L-7949 ..... c19 N72-12531*#
L-7976 ..... c12 N72-12209*#
L-8019 ..... c01 N72-11898*#

LA-DC-12495 ..... c29 N72-12812 #

LA-4622 ..... c22 N72-12619 #
LA-4677 ..... c24 N72-12696 #
LA-4692 ..... c23 N72-12660 #
LA-4697 ..... c22 N72-12617 #

LB/G-3012 ..... c11 N72-12197 #

LC-70-169175 ..... c31 N72-12873*#

LETI/ME-656 ..... c10 N72-12159 #

LETTER-RELEASE-27 ..... c22 N72-12616 #

LMSC-A995668 ..... c27 N72-12777*#

LMSC-TM-54/50-153 ..... c08 N72-12123*#

LMSC/HREC-D162799-A ..... c08 N72-12123*#
LMSC/HREC-D225410 ..... c32 N72-12914*#

LNF-70/62 ..... c11 N72-12193 #

LR-550 ..... c12 N72-12208 #

LRBA-1-031-NT-1/SAE ..... c11 N72-12199 #

LTR-490-213 ..... c31 N72-12872*#

M-367 ..... c32 N72-12920*#
M-3650 ..... c34 N72-12971 #

MAT-112 ..... c18 N72-12510 #

MCR-71-223 ..... c28 N72-12789*#
MCR-71-256 ..... c03 N72-11983*#
MCR-71-270 ..... c30 N72-12832*#
MCR-71-329 ..... c04 N72-12012*#

MDC-G-2055 ..... c24 N72-12699 #
MDC-G-2624 ..... c05 N72-12046*#
MDC-G-2625 ..... c05 N72-12047*#

ME/A-71-6 ..... c12 N72-12217 #

MF-63 ..... c12 N72-12230 #

MG/S/7/71 ..... c32 N72-12927 #

MIMEOGRAPH-SER-25 ..... c19 N72-12537 #

MIT-3966-3 ..... c32 N72-12923 #

MLM-1817 ..... c22 N72-12609 #

MODIFICATION-4 ..... c13 N72-12342*#

MRC-DA-296 ..... c18 N72-12520 #

MS-7102 ..... c12 N72-12237 #

MSC-TRW-TASK-E-98A ..... c08 N72-12124*#

MSC-01814-VOL-1 ..... c05 N72-12052*#
MSC-01814-VOL-2 ..... c05 N72-12053*#
MSC-01816-BK-1 ..... c05 N72-12054*#
MSC-01816-BK-2 ..... c05 N72-12055*#
MSC-03330 ..... c31 N72-12896*#
MSC-03742-VOL-1 ..... c13 N72-12248*#
MSC-03742-VOL-2 ..... c13 N72-12269*#
MSC-03742-VOL-3 ..... c13 N72-12295*#

MS128V0010-VOL-1 ..... c05 N72-12052*#
MS128V0010-VOL-2 ..... c05 N72-12053*#
MS128W0002-BK-1 ..... c05 N72-12054*#
MS128W0002-BK-2 ..... c05 N72-12055*#

MT-63 ..... c15 N72-12412 #

MTB-73 ..... c15 N72-12407
MTB-74-PT-1 ..... c19 N72-12525

MTI-71TR27 ..... c15 N72-12426 #

MTP-7-3-5 ..... c02 N72-11972 #
MTP-8-3-172 ..... c24 N72-12726 #

NA-70-158 ..... c02 N72-11943*#
NA-70-327-2 ..... c02 N72-11969 #

NADC-MA-7108 ..... c14 N72-12404 #
NADC-MA-7133 ..... c17 N72-12472 #
NADC-MA-7145 ..... c18 N72-12523 #

NADC-ST-7009 ..... c32 N72-12928 #
NADC-ST-7108 ..... c02 N72-11968 #

NAMRL-1129 ..... c04 N72-12032 #
NAMRL-1129 ..... c04 N72-12033 #

NASA-CASE-GSC-10087-3 ..... c07 N72-12080*
NASA-CASE-GSC-10185-1 ..... c07 N72-12081*

NASA-CASE-MFS-20180 ..... c16 N72-12440*

NASA-CASE-NPO-10637 ..... c15 N72-12409*

NASA-CASE-XER-09521 ..... c09 N72-12136*

NASA-CASE-XLA-05966 ..... c15 N72-12408*

NASA-CR-1726 ..... c05 N72-12048*#
NASA-CR-1782 ..... c32 N72-12907*#
NASA-CR-1797 ..... c12 N72-12222*#
NASA-CR-1798 ..... c21 N72-12575*#
NASA-CR-1801 ..... c32 N72-12917*#
NASA-CR-1830 ..... c15 N72-12424*#
NASA-CR-1831 ..... c12 N72-12223*#
NASA-CR-1857 ..... c33 N72-12949*#
NASA-CR-1866 ..... c22 N72-12606*#
NASA-CR-1867 ..... c08 N72-12118*#
NASA-CR-1874 ..... c11 N72-12182*#
NASA-CR-1876 ..... c11 N72-12183*#
NASA-CR-1888 ..... c05 N72-12060*#
NASA-CR-1891 ..... c02 N72-11957*#
NASA-CR-1895 ..... c22 N72-12597*#
NASA-CR-1906 ..... c23 N72-12657*#
NASA-CR-1908 ..... c12 N72-12225*#
NASA-CR-1921 ..... c23 N72-12630*#
NASA-CR-1923 ..... c12 N72-12226*#
NASA-CR-1939 ..... c29 N72-12807*#
NASA-CR-1942 ..... c20 N72-12546*#
NASA-CR-1943 ..... c17 N72-12458*#
NASA-CR-1952 ..... c05 N72-12049*#
NASA-CR-1959-SUPPL ..... c32 N72-12905*#
NASA-CR-1963 ..... c12 N72-12215*#
NASA-CR-62077 ..... c02 N72-11950*#
NASA-CR-72735 ..... c15 N72-12413*#
NASA-CR-72844 ..... c15 N72-12421*#
NASA-CR-72872 ..... c03 N72-11978*#
NASA-CR-72875 ..... c31 N72-12880*#
NASA-CR-72900 ..... c18 N72-12511*#
NASA-CR-73349 ..... c14 N72-12378*#
NASA-CR-111952 ..... c07 N72-12089*#
NASA-CR-111965 ..... c33 N72-12940*#
NASA-CR-111984 ..... c31 N72-12871*#
NASA-CR-111988 ..... c32 N72-12905*#
NASA-CR-111999 ..... c05 N72-12047*#
NASA-CR-112000 ..... c05 N72-12046*#
NASA-CR-112005 ..... c26 N72-12769*#
NASA-CR-114305 ..... c12 N72-12202*#

NASA-CR-114377 ..... c06 N72-12067*#
NASA-CR-114380 ..... c34 N72-12963*#
NASA-CR-114381 ..... c34 N72-12964*#
NASA-CR-114385 ..... c30 N72-12821*#
NASA-CR-114386 ..... c01 N72-11889*#
NASA-CR-114387 ..... c01 N72-11890*#
NASA-CR-114388 ..... c01 N72-11891*#
NASA-CR-115224 ..... c31 N72-12872*#
NASA-CR-115228 ..... c05 N72-12054*#
NASA-CR-115229 ..... c05 N72-12053*#
NASA-CR-115230 ..... c05 N72-12055*#
NASA-CR-115231 ..... c05 N72-12052*#
NASA-CR-115237 ..... c13 N72-12324*#
NASA-CR-115241 ..... c33 N72-12954*#
NASA-CR-115242 ..... c33 N72-12953*#
NASA-CR-115243 ..... c04 N72-12015*#
NASA-CR-115244 ..... c04 N72-12017*#
NASA-CR-115245 ..... c07 N72-12095*#
NASA-CR-115248 ..... c21 N72-12589*#
NASA-CR-115252 ..... c30 N72-12849*#
NASA-CR-115262 ..... c04 N72-12025*#
NASA-CR-115277 ..... c31 N72-12896*#
NASA-CR-115278 ..... c15 N72-12422*#
NASA-CR-115279 ..... c08 N72-12124*#
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NASA-CR-115282 ..... c07 N72-12094*#
NASA-CR-115283 ..... c33 N72-12951*#
NASA-CR-116773 ..... c02 N72-11943*#
NASA-CR-120002 ..... c31 N72-12879*#
NASA-CR-120006 ..... c31 N72-12877*#
NASA-CR-120009 ..... c31 N72-12878*#
NASA-CR-120015 ..... c31 N72-12860*#
NASA-CR-120029 ..... c31 N72-12895*#
NASA-CR-120812 ..... c03 N72-11987*#
NASA-CR-120821 ..... c28 N72-12793*#
NASA-CR-121022 ..... c09 N72-12137*#
NASA-CR-121031 ..... c31 N72-12882*#
NASA-CR-121034 ..... c14 N72-12375*#
NASA-CR-121035 ..... c33 N72-12944*#
NASA-CR-121038 ..... c15 N72-12416*#
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NASA-CR-121042 ..... c32 N72-12915*#
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NASA-CR-121057 ..... c12 N72-12228*#
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NASA-CR-122294 ..... c31 N72-12859*#
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NASA-CR-122296 ..... c03 N72-11982*#
NASA-CR-122297 ..... c08 N72-12114*#
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NASA-CR-122306 ..... c13 N72-12342*#
NASA-CR-122307 ..... c23 N72-12658*#
NASA-CR-122308 ..... c11 N72-12181*#
NASA-CR-122309 ..... c08 N72-12120*#
NASA-CR-123266 ..... c21 N72-12576*#
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NASA-CR-123420 ..... c34 N72-12966*#
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NASA-CR-123478 ..... c16 N72-12444*#
NASA-CR-123479 ..... c23 N72-12629*#
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NASA-CR-123481 ..... c14 N72-12394*#
NASA-CR-124541 ..... c32 N72-12919*#
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NASA-CR-124544 ..... c25 N72-12742*#
NASA-CR-124569 ..... c25 N72-12741*#
NASA-CR-124570 ..... c07 N72-12093*#
NASA-CR-124571 ..... c08 N72-12117*#
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NASA-CR-124576 ..... c22 N72-12605*#
NASA-CR-124577 ..... c08 N72-12111*#
NASA-CR-124578 ..... c29 N72-12811*#
NASA-CR-124580 ..... c29 N72-12810*#
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NASA-CR-124603 ..... c13 N72-12339*#
NASA-CR-124604 ..... c12 N72-12211*#
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NASA-CR-124613 ..... c19 N72-12527*#
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NASA-CR-124615 ..... c12 N72-12207*#
NASA-CR-124617 ..... c03 N72-11977*#
NASA-CR-124618 ..... c12 N72-12210*#
NASA-CR-124619 ..... c04 N72-12012*#
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NASA-CR-124625 ..... c21 N72-12577*#
NASA-CR-124626 ..... c27 N72-12777*#
NASA-CR-124627 ..... c23 N72-12626*#
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NASA-CR-124630 ..... c03 N72-11984*#
NASA-CR-124631 ..... c03 N72-11985*#
NASA-CR-124632 ..... c07 N72-12092*#
NASA-CR-124632 ..... c28 N72-12789*#
NASA-CR-124633 ..... c30 N72-12845*#
NASA-CR-124635 ..... c13 N72-12335*#
NASA-CR-124636 ..... c24 N72-12682*#
NASA-CR-124637 ..... c24 N72-12683*#
NASA-CR-124638 ..... c28 N72-12788*#
NASA-CR-124639 ..... c30 N72-12837*#
NASA-CR-124640 ..... c21 N72-12580*#
NASA-CR-124641 ..... c30 N72-12836*#
NASA-CR-124642 ..... c31 N72-12884*#
NASA-CR-124643 ..... c14 N72-12380*#
NASA-CR-124644 ..... c30 N72-12857*#
NASA-CR-124645 ..... c18 N72-12513*#
NASA-CR-124645 ..... c33 N72-12945*#
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NASA-CR-124647 ..... c22 N72-12603*#
NASA-CR-124672 ..... c09 N72-12141*#
NASA-CR-124674 ..... c09 N72-12142*#
NASA-CR-124841 ..... c30 N72-12818*#
NASA-CR-124842 ..... c13 N72-12341*#

NASA-SER-H-1009-VOL-1 ..... c31 N72-12878*#
NASA-SER-H-1009-VOL-3 ..... c31 N72-12895*#

NASA-SER-S-0615 ..... c31 N72-12877*#

NASA-SP-287 ..... c31 N72-12892*#
NASA-SP-3068 ..... c24 N72-12684*#
NASA-SP-3069 ..... c27 N72-12776*#
NASA-SP-4401 ..... c31 N72-12873*#
NASA-SP-5927(02) ..... c15 N72-12423*#
NASA-SP-5946(01) ..... c07 N72-12083*#
NASA-SP-7037(10) ..... c01 N72-11852*#
NASA-SP-8077 ..... c31 N72-12891*#

NASA-TASK-160-75-71-03 ..... c13 N72-12330*#
NASA-TASK-160-75-71-03 ..... c19 N72-12530*#
NASA-TASK-160-75-73-04-10 ..... c13 N72-12328*#
NASA-TASK-160-75-73-04-10 ..... c13 N72-12329*#

NASA-TM-X-2326 ..... c02 N72-11956*#
NASA-TM-X-2376 ..... c33 N72-12947*#
NASA-TM-X-2383 ..... c31 N72-12876*#
NASA-TM-X-2397 ..... c28 N72-12780*#
NASA-TM-X-2398 ..... c01 N72-11895*#
NASA-TM-X-2401 ..... c31 N72-12885*#
NASA-TM-X-2404 ..... c17 N72-12457*#
NASA-TM-X-2406 ..... c28 N72-12785*#
NASA-TM-X-2409 ..... c12 N72-12209*#
NASA-TM-X-2413 ..... c01 N72-11900*#
NASA-TM-X-2420 ..... c30 N72-12833*#
NASA-TM-X-2422 ..... c28 N72-12779*#
NASA-TM-X-2425 ..... c22 N72-12604*#
NASA-TM-X-2426 ..... c01 N72-11894*#
NASA-TM-X-2427 ..... c32 N72-12913*#
NASA-TM-X-2432 ..... c03 N72-11980*#
NASA-TM-X-2435 ..... c22 N72-12598*#
NASA-TM-X-2443 ..... c06 N72-12070*#
NASA-TM-X-2450 ..... c33 N72-12946*#
NASA-TM-X-58070 ..... c30 N72-12830*#

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NASA-TM-X-62079 ..... c01 N72-11902*#
NASA-TM-X-62093 ..... c30 N72-12829*#
NASA-TM-X-62094 ..... c02 N72-11942*#
NASA-TM-X-63930 ..... c08 N72-12113*#
NASA-TM-X-64621 ..... c30 N72-12840*#
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NASA-TM-X-64623 ..... c11 N72-12165*#
NASA-TM-X-64624 ..... c11 N72-12180*#
NASA-TM-X-64625 ..... c09 N72-12138*#
NASA-TM-X-64626 ..... c17 N72-12462*#
NASA-TM-X-65458 ..... c24 N72-12677*#
NASA-TM-X-65565 ..... c13 N72-12331*#
NASA-TM-X-65700 ..... c24 N72-12677*#
NASA-TM-X-65750 ..... c31 N72-12874*#
NASA-TM-X-65751 ..... c30 N72-12822*#
NASA-TM-X-65755 ..... c07 N72-12084*#
NASA-TM-X-65758 ..... c30 N72-12825*#
NASA-TM-X-65759 ..... c30 N72-12824*#
NASA-TM-X-65760 ..... c30 N72-12823*#
NASA-TM-X-65761 ..... c29 N72-12802*#
NASA-TM-X-65762 ..... c31 N72-12887*#
NASA-TM-X-65763 ..... c08 N72-12115*#
NASA-TM-X-65764 ..... c26 N72-12767*#
NASA-TM-X-65765 ..... c13 N72-12338*#
NASA-TM-X-65766 ..... c10 N72-12155*#
NASA-TM-X-65767 ..... c30 N72-12844*#
NASA-TM-X-65768 ..... c14 N72-12382*#
NASA-TM-X-65769 ..... c13 N72-12337*#
NASA-TM-X-65771 ..... c30 N72-12843*#
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NASA-TM-X-65774 ..... c13 N72-12336*#
NASA-TM-X-65775 ..... c13 N72-12340*#
NASA-TM-X-67384 ..... c21 N72-12863*#
NASA-TM-X-67391 ..... c14 N72-12372*
NASA-TM-X-67401 ..... c31 N72-12875*#
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NASA-TM-X-67413 ..... c01 N72-11869*#
NASA-TM-X-67414 ..... c01 N72-11870*#
NASA-TM-X-67415 ..... c11 N72-11872*#
NASA-TM-X-67416 ..... c01 N72-11878*#
NASA-TM-X-67417 ..... c11 N72-11879*#
NASA-TM-X-67418 ..... c11 N72-11880*#
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NASA-TM-X-67455 ..... c14 N72-12371*
NASA-TM-X-67456 ..... c14 N72-12370*
NASA-TM-X-67903 ..... c28 N72-12784*#
NASA-TM-X-67907 ..... c01 N72-11897*#
NASA-TM-X-67943 ..... c24 N72-12676*#
NASA-TM-X-67945 ..... c22 N72-12601*#
NASA-TM-X-67947 ..... c14 N72-12379*#
NASA-TM-X-67948 ..... c18 N72-12512*#
NASA-TM-X-67950 ..... c23 N72-12628*#
NASA-TM-X-67952 ..... c13 N72-12327*#
NASA-TM-X-67953 ..... c05 N72-12056*#
NASA-TM-X-67955 ..... c22 N72-12602*#
NASA-TM-X-67956 ..... c25 N72-12735*#
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NASA-TM-X-67958 ..... c22 N72-12600*#
NASA-TM-X-67960 ..... c33 N72-12942*#
NASA-TM-X-67961 ..... c28 N72-12783*#
NASA-TM-X-67962 ..... c33 N72-12943*#
NASA-TM-X-67964 ..... c28 N72-12781*#
NASA-TM-X-67966 ..... c22 N72-12599*#
NASA-TM-X-67968 ..... c08 N72-12112*#
NASA-TM-X-67969 ..... c16 N72-12443*#
NASA-TM-X-67971 ..... c28 N72-12782*#
NASA-TM-X-67974 ..... c23 N72-12627*#
NASA-TM-X-67975 ..... c11 N72-12166*#
NASA-TM-X-68801 ..... c31 N72-12858*#

NASA-TN-D-6458 ..... c31 N72-12883*#
NASA-TN-D-6479 ..... c32 N72-12918*#
NASA-TN-D-6484 ..... c33 N72-12939*#
NASA-TN-D-6485 ..... c32 N72-12920*#
NASA-TN-D-6486 ..... c02 N72-11948*#
NASA-TN-D-6498 ..... c17 N72-12466*#
NASA-TN-D-6501 ..... c23 N72-12631*#
NASA-TN-D-6502 ..... c19 N72-12526*#
NASA-TN-D-6515 ..... c17 N72-12468*#
NASA-TN-D-6531 ..... c01 N72-11896*#
NASA-TN-D-6535 ..... c09 N72-12139*#
NASA-TN-D-6537 ..... c01 N72-11888*#
NASA-TN-D-6544 ..... c32 N72-12911*#
NASA-TN-D-6546 ..... c33 N72-12941*#
NASA-TN-D-6547 ..... c25 N72-12743*#
NASA-TN-D-6549 ..... c19 N72-12531*#
NASA-TN-D-6556 ..... c12 N72-12219*#
NASA-TN-D-6557 ..... c32 N72-12912*#
NASA-TN-D-6562 ..... c17 N72-12465*#
NASA-TN-D-6563 ..... c15 N72-12419*#
NASA-TN-D-6566 ..... c12 N72-12214*#
NASA-TN-D-6570 ..... c32 N72-12908*#
NASA-TN-D-6580 ..... c01 N72-11898*#
NASA-TN-D-6582 ..... c01 N72-11899*#
NASA-TN-D-6587 ..... c12 N72-12216*#
NASA-TN-D-6591 ..... c28 N72-12786*#
NASA-TN-D-6593 ..... c28 N72-12790*#
NASA-TN-D-6601 ..... c05 N72-12059*#
NASA-TN-D-6608 ..... c15 N72-12420*#
NASA-TN-D-6619 ..... c02 N72-11949*#

NASA-TR-R-371 ..... c03 N72-11986*#
NASA-TR-R-372 ..... c31 N72-12886*#
NASA-TR-R-379 ..... c01 N72-11853*#

NASA-TT-F-13723 ..... c29 N72-12806*#
NASA-TT-F-13764 ..... c14 N72-12384*#
NASA-TT-F-13766 ..... c30 N72-12831*#
NASA-TT-F-13777 ..... c19 N72-12529*#
NASA-TT-F-13968 ..... c17 N72-12455*#
NASA-TT-F-13984 ..... c01 N72-11893*#
NASA-TT-F-13990 ..... c04 N72-12016*#
NASA-TT-F-14013 ..... c17 N72-12459*#
NASA-TT-F-14017 ..... c04 N72-12024*#
NASA-TT-F-14026 ..... c04 N72-12013*#
NASA-TT-F-14027 ..... c05 N72-12050*#
NASA-TT-F-14033 ..... c12 N72-12221*#
NASA-TT-F-14036 ..... c17 N72-12461*#
NASA-TT-F-14037 ..... c17 N72-12469*#
NASA-TT-F-14041 ..... c18 N72-12514*#
NASA-TT-F-14044 ..... c15 N72-12414*#
NASA-TT-F-14045 ..... c26 N72-12768*#
NASA-TT-F-14047 ..... c20 N72-12550*#
NASA-TT-F-14048 ..... c04 N72-12014*#
NASA-TT-F-14051 ..... c24 N72-12675*#
NASA-TT-F-14052 ..... c17 N72-12463*#
NASA-TT-F-14053 ..... c18 N72-12516*#
NASA-TT-F-14054 ..... c17 N72-12464*#
NASA-TT-F-14056 ..... c02 N72-11955*#
NASA-TT-F-14057 ..... c02 N72-11944*#
NASA-TT-F-14064 ..... c04 N72-12023*#
NASA-TT-F-14065 ..... c14 N72-12383*#
NASA-TT-F-14068 ..... c04 N72-12022*#
NASA-TT-F-14070 ..... c04 N72-12021*#
NASA-TT-F-14071 ..... c12 N72-12212*#
NASA-TT-F-14077 ..... c16 N72-12442*#
NASA-TT-F-14078 ..... c13 N72-12321*#
NASA-TT-F-14079 ..... c13 N72-12322*#
NASA-TT-F-14080 ..... c20 N72-12547*#
NASA-TT-F-14081 ..... c31 N72-12890*#
NASA-TT-F-14082 ..... c29 N72-12805*#

NAVSHIPS-0911-000-9010-13 ..... c32 N72-12929 #

NBL-258 ..... c06 N72-12072 #

NBS-SP-260-31 ..... c33 N72-12948*#

NBS-TN-270-6 ..... c33 N72-12952 #
NBS-TN-552 ..... c08 N72-12122 #

NBS-10396 ..... c14 N72-12388 #
NBS-10453 ..... c21 N72-12586 #
NBS-10606 ..... c21 N72-12583 #

NCEL-TR-729 ..... c15 N72-12433 #

NEAR-TR-25 ..... c12 N72-12222*#

NEDO-RR-9-71 ..... c04 N72-12038 #

NEL-473 ..... c14 N72-12374 #
NEL-474 ..... c33 N72-12938 #

NLL-AERE-TRANS-1131-(9091.9F) c33 N72-12937

NLL-LB/G/3079-(9091.9F) c18 N72-12490

NLL-PORS-TRANS-2778-(9022.81) c06 N72-12065
NLL-PORS-TRANS-2784-(9022.81) c09 N72-12135
NLL-PORS-TRANS-2787-(9022.81) c18 N72-12491

MLL-RISLEY-TR-2216-(9091.9F) c22 N72-12596
MLL-RISLEY-TR-2221-(9091.9F) c15 N72-12406

MLL-TRANS-LB/G/3085-(9091.9F) c17 N72-12454

NOAA-TM-ERL-NSSL-53 ..... c20 N72-12551 #

NOAA-TR-ERL-206-APCL-20 ..... c13 N72-12335*#

NOLTR-71-53 ..... c18 N72-12518 #
NOLTR-71-61 ..... c33 N72-12962 #
NOLTR-71-93 ..... c12 N72-12239 #

NP-18805 ..... c25 N72-12752 #
NP-18877 ..... c14 N72-12389 #
NP-18916 ..... c25 N72-12746 #
NP-18917 ..... c25 N72-12747 #
NP-18930 ..... c11 N72-12184 #
NP-18947 ..... c25 N72-12749 #

NPL-AERO-SR-038 ..... c01 N72-11909 #

NPL-AERO-1283 ..... c02 N72-11960 #
NPL-AERO-1309 ..... c01 N72-11904 #

NPL-DNAC-4 ..... c19 N72-12536 #

NPS-57BP7161A ..... c32 N72-12935 #

NR-137-770 ..... c17 N72-12474 #
NR-372-012 ..... c16 N72-12444*#

NRC-TT-1492 ..... c06 N72-12069 #
NRC-TT-1498 ..... c04 N72-12019 #

NRC-12235-PT-2 ..... c15 N72-12412 #
NRC-12236 ..... c12 N72-12208 #

NRL-MR-2256 ..... c25 N72-12758 #
NRL-MR-2283 ..... c25 N72-12762 #
NRL-MR-2286 ..... c26 N72-12772 #
NRL-MR-2305 ..... c11 N72-12201 #

NRL-501-12 ..... c13 N72-12367 #
NRL-501-40 ..... c13 N72-12367 #
NRL-7207 ..... c23 N72-12669 #
NRL-7272 ..... c07 N72-12110 #
NRL-7280 ..... c07 N72-12104 #
NRL-7285 ..... c13 N72-12367 #
NRL-7286 ..... c17 N72-12481 #

NSSDC-ID-71-008A-01 ..... c14 N72-12370*

NSSDC-71-16A-PT-1 ..... c14 N72-12370*
NSSDC-71-16B-PT-2 ..... c14 N72-12371*
NSSDC-71-16C-PT-3 ..... c14 N72-12372*

NSTIC-29818 ..... c09 N72-12147 #
NSTIC-30367 ..... c08 N72-12127 #

NTSB-AAR-71-13 ..... c02 N72-11945 #

NUC-TP-224 ..... c13 N72-12368 #

NUSC-4051 ..... c07 N72-12101 #

NWC-EES-71-605 ..... c20 N72-12559 #

NWC-TP-5182 ..... c27 N72-12778 #
NWC-TP-5206 ..... c28 N72-12801 #

NWL-TR-2560 ..... c33 N72-12958 #

NYO-844-84 ..... c06 N72-12071 #
NYO-1480-170 ..... c12 N72-12230 #
NYO-2150-73 ..... c23 N72-12659 #
NYO-2804-38 ..... c04 N72-12029 #
NYO-2804-39 ..... c04 N72-12028 #
NYO-3399-246 ..... c24 N72-12710 #
NYO-3562-3 ..... c20 N72-12552 #
NYO-3699-55 ..... c26 N72-12770 #
NYO-3930-11 ..... c15 N72-12426 #
NYO-4078-4 ..... c17 N72-12470 #

OG-9 ..... c29 N72-12810*#
OG-57 ..... c24 N72-12687*#

ONERA-TN-173 ..... c12 N72-12221*#

ONERA-TP-952 ..... c21 N72-12574 #
ONERA-TP-975 ..... c12 N72-12205 #
ONERA-TP-976 ..... c12 N72-12206 #
ONERA-TP-980 ..... c25 N72-12733 #
ONERA-TP-985 ..... c12 N72-12204 #

ONRL-R-15-71 ..... c34 N72-12972 #
ONRL-R-17-71 ..... c01 N72-11911 #
ONRL-R-26-71 ..... c07 N72-12103 #

OPERATIONS-REQ-7015 ..... c31 N72-12893 #
OPERATIONS-REQ-7016 ..... c31 N72-12894 #

ORG-71-3 ..... c07 N72-12110 #

ORNL-TM-3358 ..... c22 N72-12624 #
ORNL-TM-3384 ..... c22 N72-12623 #
ORNL-TM-3389 ..... c22 N72-12615 #
ORNL-TM-3449 ..... c22 N72-12612 #

ORNL-4688 ..... c24 N72-12700 #

ORO-3819-3 ..... c25 N72-12754 #
ORO-3819-4 ..... c25 N72-12753 #
ORO-3844-7 ..... c04 N72-12027 #

OT/ITSTM-34 ..... c08 N72-12133 #
OT/ITSTM-38 ..... c07 N72-12106 #
OT/ITSTM-39 ..... c08 N72-12132 #
OT/ITSTM-44 ..... c07 N72-12096 #

OU-LNS-71-1 ..... c24 N72-12719 #
OU-LNS-71-2 ..... c24 N72-12722 #

P-184 ..... c02 N72-11953 #
P-743 ..... c23 N72-12666 #

PB-201534 ..... c20 N72-12559 #
PB-201664 ..... c32 N72-12927 #

PD-13078 ..... c31 N72-12894 #
PD-13079 ..... c31 N72-12893 #

PPAR-24 ..... c11 N72-12186 #

PR-22 ..... c29 N72-12814 #
PR-29 ..... c29 N72-12813 #
PR-30 ..... c30 N72-12853 #
PR-37 ..... c13 N72-12350 #
PR-42 ..... c19 N72-12533 #
PR-55 ..... c30 N72-12831*#
PR-57 ..... c04 N72-12018 #
PR-63 ..... c14 N72-12384*#
PR-71 ..... c30 N72-12838 #
PR-74 ..... c24 N72-12678 #
PR-81 ..... c25 N72-12736 #
PR-0002 ..... c29 N72-12806*#
PR-2420-M03 ..... c18 N72-12513*#

PROBLEM-6 ..... c12 N72-12239 #

PUB-70-1364-00-00 ..... c02 N72-11942*#

PUBL-71-3 ..... c33 N72-12945*#

PWA-FR-3827 ..... c28 N72-12796 #

P2-5496 ..... c24 N72-12675*#

QAD-MATS-168 ..... c14 N72-12393 #

QPR-3 ..... c31 N72-12888*#
QPR-4 ..... c16 N72-12447 #

QR-2 ..... c09 N72-12146 #
QR-10 ..... c24 N72-12699 #

R-510 ..... c25 N72-12759 #

RADC-TR-71-94 ..... c07 N72-12100 #
RADC-TR-71-95 ..... c09 N72-12150 #
RADC-TR-71-101 ..... c07 N72-12099 #
RADC-TR-71-156 ..... c09 N72-12151 #

RAE-TM-813 ..... c01 N72-11892 #

RAE-TN-AERO-2685 ..... c02 N72-11962 #

RAE-TR-68104 ..... c01 N72-11903 #
RAE-TR-68231 ..... c14 N72-12391 #
RAE-TR-69073 ..... c01 N72-11910 #
RAE-TR-69090 ..... c02 N72-11963 #
RAE-TR-69261 ..... c20 N72-12553 #
RAE-TR-69271 ..... c02 N72-11965 #
RAE-TR-69281 ..... c02 N72-11964 #
RAE-TR-70020 ..... c31 N72-12899 #
RAE-TR-70034 ..... c20 N72-12554 #
RAE-TR-70079 ..... c02 N72-11961 #
RAE-TR-70083 ..... c33 N72-12957 #
RAE-TR-70092 ..... c03 N72-11979 #
RAE-TR-70102 ..... c08 N72-12125 #
RAE-TR-70133 ..... c14 N72-12392 #
RAE-TR-70145 ..... c32 N72-12925 #
RAE-TR-70159 ..... c18 N72-12510 #
RAE-TR-70168 ..... c02 N72-11967 #
RAE-TR-70184 ..... c11 N72-12198 #
RAE-TR-70185 ..... c01 N72-11907 #
RAE-TR-70222 ..... c21 N72-12590 #
RAE-TR-71053 ..... c13 N72-12351 #
RAE-TR-71082 ..... c31 N72-12899 #

RD-TM-71-4 ..... c31 N72-12904 #

RD-TR-71-4 ..... c12 N72-12236 #

RD-620:63965 ..... c21 N72-12587 #

RE-416 ..... c24 N72-12680 #

REF-71-3 ..... c13 N72-12362 #

REPT-7L-40 ..... c25 N72-12741*#
REPT-7L-46 ..... c25 N72-12742*#
REPT-9 ..... c17 N72-12460*#
REPT-11/71 ..... c16 N72-12441 #
REPT-17 ..... c13 N72-12246 #
REPT-18 ..... c13 N72-12245 #
REPT-22-6560-PT-7 ..... c12 N72-12227*#
REPT-44 ..... c13 N72-12325 #
REPT-61 ..... c02 N72-11959 #
REPT-71-PVP-26 ..... c32 N72-12922 #
REPT-71-0-1918 ..... c13 N72-12326*#
REPT-71-1 ..... c17 N72-12477 #
REPT-71-5 ..... c28 N72-12798 #
REPT-71-8 ..... c23 N72-12663 #
REPT-71-10 ..... c25 N72-12734*#
REPT-72-02 ..... c26 N72-12774 #
REPT-72-04 ..... c26 N72-12775 #
REPT-72-12 ..... c21 N72-12577*#
REPT-72/6 ..... c02 N72-11951*#
REPT-106-048 ..... c08 N72-12119 #
REPT-113-30-PT-2 ..... c12 N72-12229*#
REPT-113-30-PT-7 ..... c12 N72-12227*#
REPT-221.12-1E/71 ..... c21 N72-12582 #
REPT-221.12-2E/71 ..... c21 N72-12584 #
REPT-230-F ..... c13 N72-12244 #
REPT-0970-296 ..... c09 N72-12153 #
REPT-1070-13800-F ..... c15 N72-12430 #
REPT-1154-12 ..... c16 N72-12447 #
REPT-1573 ..... c23 N72-12659 #
REPT-1721-2 ..... c13 N72-12328*#
REPT-2091 ..... c32 N72-12915*#
REPT-5273 ..... c15 N72-12425 #
REPT-6477 ..... c07 N72-12090 #
REPT-7142-54-X ..... c23 N72-12664 #
REPT-9050 ..... c05 N72-12062 #
REPT-12609-FR1-VOL-3 ..... c02 N72-11974 #
REPT-14254 ..... c17 N72-12474 #
REPT-043680-18-T ..... c32 N72-12910*#

RF-2421 ..... c21 N72-12575*#

RIFP-129 ..... c26 N72-12766 #

RISO-M-1386 ..... c11 N72-12195 #

RL-TR-71-4 ..... c06 N72-12077 #

RLO-1388-139 ..... c24 N72-12724 #

RM-524 ..... c28 N72-12787 #
RM-525 ..... c17 N72-12467 #

ROE-STS-115 ..... c31 N72-12901 #

RP-69 ..... c19 N72-12532 #

RPE-TR-70/11 ..... c28 N72-12797 #

RPI-328-209 ..... c24 N72-12690 #

RPP/R-8 ..... c11 N72-12194 #
RPP/R-9 ..... c24 N72-12697 #

REC-A-193-PT-2 ..... c13 N72-12333 #

RT/ING-(71)1 ..... c14 N72-12390 #

R0032 ..... c24 N72-12699 #

S-3203-11228 ..... c07 N72-12104 #

SAD-1970/7(S) ..... c13 N72-12332 #

SAMSO-TR-71-145 ..... c29 N72-12816 #

SAO-SPECIAL-REPT-309 ..... c08 N72-12119 #
SAO-SPECIAL-REPT-334 ..... c29 N72-12808 #
SAO-SPECIAL-REPT-339 ..... c13 N72-12339*#

SAO-103-054 ..... c13 N72-12339*#

SATR-2 ..... c17 N72-12486 #

SC-CR-715084 ..... c25 N72-12755 #

SC-RR-69-804 ..... c30 N72-12852 #

SD-68-368 ..... c30 N72-12819 #
SD-71-343 ..... c31 N72-12896*#

SG-66 ..... c13 N72-12333 #

SIER-71-0282 ..... c15 N72-12416*#

SIL-106 ..... c33 N72-12949*#

SIT-P263(10/71) ..... c23 N72-12626*#

SM-231 ..... c09 N72-12153 #

SMU-80-36 ..... c13 N72-12366 #

SR-2 ..... c09 N72-12149 #
SR-18 ..... c25 N72-12734*#

SRFB-059 ..... c31 N72-12894 #
SRFB-060 ..... c31 N72-12893 #

SU-IPR-415 ..... c25 N72-12761 #

SU-1206-246 ..... c24 N72-12710 #
SU-1206-250 ..... c24 N72-12711 #

S12/222 ..... c02 N72-11952 #

T-29 ..... c28 N72-12788*#

TASK-AM-A-70-PSY-23 ..... c05 N72-12061 #

TASK-AM-B-71-PSY-23 ..... c05 N72-12061 #

TASK-AM-C-69-PSY-5 ..... c05 N72-12061 #

TASK-NR-387-047 ..... c13 N72-12361 #

TASK-1C162203D14413 ..... c28 N72-12795 #
TASK-1G162203D14413 ..... c28 N72-12796 #
TASK-707A ..... c07 N72-12095*#
TASK-0580 ..... c13 N72-12368 #
TASK-4070 ..... c13 N72-12367 #
TASK-61102F ..... c02 N72-11973 #
TASK-61102F ..... c12 N72-12238 #
TASK-61102F ..... c23 N72-12670 #
TASK-61102F ..... c32 N72-12931 #
TASK-62701D ..... c13 N72-12365 #
TASK-681304 ..... c02 N72-11973 #
TASK-681306 ..... c23 N72-12670 #
TASK-681307 ..... c12 N72-12238 #
TASK-681307 ..... c32 N72-12931 #
TASK-734202 ..... c32 N72-12933 #
TASK-735001 ..... c18 N72-12519 #
TASK-735105 ..... c17 N72-12482 #

TASK-735106 ..... c17 N72-12479 #
TASK-735301 ..... c32 N72-12932 #
TASK-735303 ..... c17 N72-12483 #
TASK-869205 ..... c30 N72-12857*#

TECH-29 ..... c29 N72-12811*#

TH-71-E-21 ..... c10 N72-12154 #
TH-71-E-22 ..... c21 N72-12573 #

THEMIS-UM-71-2 ..... c32 N72-12936 #
THEMIS-UM-71-3 ..... c15 N72-12439 #

TID-25756 ..... c22 N72-12625 #
TID-50551 ..... c13 N72-12331*#

TM-35 ..... c20 N72-12566 #
TM-71-1022-3 ..... c21 N72-12576*#

TN-1971-10 ..... c21 N72-12594 #

TP-1999 ..... c09 N72-12146 #

TR-IC039 ..... c14 N72-12378*#

TR-T-71-1 ..... c13 N72-12361 #

TR-1 ..... c24 N72-12732 #
TR-2 ..... c31 N72-12882*#
TR-3 ..... c17 N72-12475 #
TR-4 ..... c14 N72-12385*#
TR-21 ..... c32 N72-12930 #
TR-69 ..... c13 N72-12362 #
TR-70-091 ..... c14 N72-12377 #
TR-71-3 ..... c33 N72-12959 #
TR-71-4 ..... c26 N72-12773 #
TR-71-07C ..... c31 N72-12859*#
TR-71-13 ..... c09 N72-12147 #
TR-169 ..... c08 N72-12120*#
TR-482 ..... c07 N72-12092*#
TR-625 ..... c16 N72-12444*#
TR-0172(2260-20)-6 ..... c29 N72-12816 #

TRW-13837-6001-R0-00 ..... c03 N72-11982*#
TRW-17618-H223-R0-00 ..... c07 N72-12095*#
TRW-17618-H229-R0-00 ..... c08 N72-12124*#
TRW-20690-6001-R0-00 ..... c15 N72-12422*#

TT-7107 ..... c11 N72-12161 #

TTU-3101 ..... c03 N72-11984*#

T7023012301 ..... c17 N72-12488 #
T7023012301 ..... c18 N72-12522 #

UC-20 ..... c24 N72-12700 #
UC-33 ..... c24 N72-12699 #

UCLA-ENG-7085 ..... c04 N72-12037 #
UCLA-ENG-7126 ..... c02 N72-11973 #

UCR-34-P-107-B-112 ..... c24 N72-12698 #

UCRL-TRANS-1437 ..... c09 N72-12143 #
UCRL-TRANS-1447 ..... c11 N72-12192 #

UCRL-20664 ..... c24 N72-12712 #
UCRL-51022 ..... c32 N72-12924 #
UCRL-72969 ..... c22 N72-12618 #
UCRL-73100 ..... c17 N72-12471 #

UDC-523.07 ..... c30 N72-12850 #
UDC-535.35 ..... c24 N72-12679 #
UDC-536.24:532.546 ..... c33 N72-12955 #
UDC-551.509.6 ..... c20 N72-12548 #
UDC-613.693:628.16.0809 ..... c13 N72-12334 #
UDC-620.172.2 ..... c18 N72-12510 #
UDC-621.3.032.266 ..... c11 N72-12167 #
UDC-621.314.26 ..... c03 N72-11979 #
UDC-621.375.3 ..... c24 N72-12681 #
UDC-621.396.946 ..... c07 N72-12091 #
UDC-629.7.621.44:621.919.1.002 .... c15 N72-12415 #
UDC-661.426 ..... c18 N72-12510 #

UILU-ENG-71-2213 ..... c25 N72-12759 #
UILU-ENG-71-2503 ..... c13 N72-12325 #
UILU-ENG-71-2546 ..... c25 N72-12734*#

UNICH-03371-14-T ..... c12 N72-12220 #

UNION-CALENDAR-368 ..... c34 N72-12967 #

UR-NSRL-41 ..... c24 N72-12686 #

UR-00013 ..... c12 N72-12228*#

UR/0000-70-000-000 ..... c28 N72-12800 #

US-PATENT-APPL-SN-733039 ..... c07 N72-12081*
US-PATENT-APPL-SN-771530 ..... c09 N72-12136*
US-PATENT-APPL-SN-784544 ..... c15 N72-12408*
US-PATENT-APPL-SN-851298 ..... c15 N72-12409*
US-PATENT-APPL-SN-863276 ..... c16 N72-12440*
US-PATENT-APPL-SN-880885 ..... c07 N72-12080*

US-PATENT-CLASS-60-23 ..... c15 N72-12409*
US-PATENT-CLASS-72-307 ..... c15 N72-12408*
US-PATENT-CLASS-136-202 ..... c09 N72-12136*
US-PATENT-CLASS-136-206 ..... c09 N72-12136*
US-PATENT-CLASS-136-227 ..... c09 N72-12136*
US-PATENT-CLASS-140-105 ..... c15 N72-12408*
US-PATENT-CLASS-178-DIG.12 ..... c07 N72-12081*
US-PATENT-CLASS-178-6 ..... c07 N72-12081*
US-PATENT-CLASS-178-7.3 ..... c07 N72-12081*
US-PATENT-CLASS-236-68 ..... c15 N72-12409*
US-PATENT-CLASS-325-4 ..... c07 N72-12080*
US-PATENT-CLASS-325-10 ..... c07 N72-12081*
US-PATENT-CLASS-325-13 ..... c07 N72-12081*
US-PATENT-CLASS-331-94.5 ..... c16 N72-12440*
US-PATENT-CLASS-337-75 ..... c15 N72-12409*
US-PATENT-CLASS-337-354 ..... c15 N72-12409*
US-PATENT-CLASS-337-359 ..... c15 N72-12409*
US-PATENT-CLASS-343-DIG.3 ..... c09 N72-12136*
US-PATENT-CLASS-343-6.5R c07 N72-12080*
US-PATENT-CLASS-343-6.8R c07 N72-12080*
US-PATENT-CLASS-343-720 ..... c09 N72-12136*
US-PATENT-CLASS-343-840 ..... c09 N72-12136*
US-PATENT-CLASS-350-1 ..... c16 N72-12440*
US-PATENT-CLASS-350-312 ..... c16 N72-12440*

US-PATENT-3,584,660 ..... c15 N72-12408*
US-PATENT-3,588,331 ..... c07 N72-12081*
US-PATENT-3,591,960 ..... c15 N72-12409*
US-PATENT-3,593,194 ..... c16 N72-12440*
US-PATENT-3,594,790 ..... c07 N72-12080*
US-PATENT-3,594,803 ..... c09 N72-12136*

USA-NLABS-TR-71-45-CE ..... c05 N72-12063 #

USAARL-71-15 ..... c04 N72-12032 #
USAARL-71-16 ..... c04 N72-12033 #

USAAVLABS-TR-70-53 ..... c28 N72-12796 #
USAAVLABS-TR-70-56 ..... c28 N72-12795 #

USCEE-406 ..... c08 N72-12121*#

USGS-222 ..... c13 N72-12341*#

USNA-TSPR-13 ..... c12 N72-12240 #
USNA-TSPR-17 ..... c07 N72-12108 #
USNA-TSPR-20 ..... c24 N72-12730 #
USNA-TSPR-22 ..... c06 N72-12078 #
USNA-TSPR-23 ..... c25 N72-12764 #

UTIAS-TN-147 ..... c11 N72-12200 #

VKI-TN-76 ..... c13 N72-12358 #

VPI-E-71-14 ..... c12 N72-12242 #
VPI-E-71-17 ..... c02 N72-11950*#

WANL-TME-1977 ..... c15 N72-12424*#

WDL-TR-4498 ..... c14 N72-12394*#

WHO-283 ..... c20 N72-12539

WRCNM-2 ..... c34 N72-12969 #

X-540-68-220 ..... c07 N72-12084*#
X-552-71-143 ..... c31 N72-12887*#
X-553-71-469 ..... c13 N72-12340*#
X-565-71-357 ..... c08 N72-12115*#
X-621-71-214 ..... c13 N72-12331*#
X-625-71-450 ..... c14 N72-12382*#
X-625-71-459 ..... c30 N72-12842*#
X-641-70-199 ..... c08 N72-12113*#

X-641-71-56 ..... c24 N72-12677*#
X-641-71-373 ..... c24 N72-12677*#
X-641-71-468 ..... c30 N72-12843*#
X-644-71-418 ..... c13 N72-12338*#
X-651-71-463 ..... c13 N72-12336*#
X-660-71-439 ..... c30 N72-12841*#
X-661-71-443 ..... c30 N72-12824*#
X-661-71-444 ..... c30 N72-12823*#
X-661-71-445 ..... c29 N72-12802*#
X-661-71-458 ..... c30 N72-12822*#
X-671-71-440 ..... c30 N72-12825*#
X-690-71-449 ..... c30 N72-12844*#
X-690-71-452 ..... c13 N72-12337*#
X-711-71-410-PT-1 ..... c26 N72-12767*#
X-752-71-448 ..... c10 N72-12155*#

X565-71-442 ..... c31 N72-12874*#

ZJE-100 ..... c22 N72-12620 #

ZMS-348G ..... c34 N72-12968 #

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By ROBERT SIEGEL AND JOHN R. HOWELL

This is the third and final volume of the *Thermal Radiation Heat Transfer* series by Siegel and Howell of Lewis Research Center. In this volume the equation of transfer and the energy equation are developed for radiation in an absorbing, emitting, and scattering media. For nonisothermal media various solution methods are given. The engineering exchange methods are developed. The combined heat transfer by conduction, convection, and radiation is discussed. Other topics include band absorption correlations, scattering by particles, soot radiation, and radiation in media with nonunity refractive index. *Paperbound.* 372 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $1.75. Volume I is subtitled "The Blackbody, Electromagnetic Theory, and Material Properties," and Volume II is "Radiation Exchange Between Surfaces and in Enclosures."

The Pioneer Mission to Jupiter (NASA SP-268)

This small publication describes in layman's terminology the forthcoming missions of Pioneer F and Pioneer G, both being readied by NASA to extend the study of interplanetary phenomena beyond the asteroid belt to Jupiter, the Sun's largest planet. Pioneer F will be launched in 1972, with Pioneer G following a year later. These spacecraft will carry 13 scientific experiments and will travel more than eight times farther from Earth than Mars. *Paperbound.* 48 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $0.30.

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